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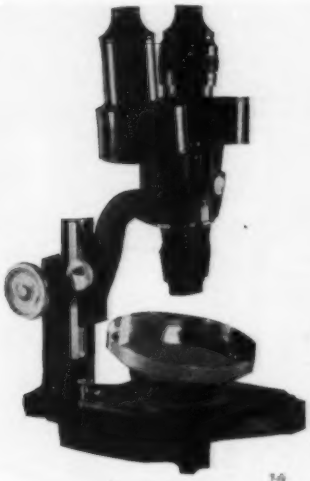

# The Examination of Cheese for Extraneous Matter

Difficulties in the detection of extraneous matter in cheese call for a positive technique in examination.

Such a method, found most suitable for all types of cheeses, including process cheese wherein organic or inorganic salts as well as gums are incorporated, is that of W. S. Greene, Microanalytical Division, Food and Drug Administration.

A printed copy of a description of this method is available on request.

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JOURNAL OF DAIRY SCIENCE

VOLUME XX AUGUST, 1937 NUMBER 8

# A NATIONAL SURVEY OF METHODS FOR THE DETERMINATION OF SEDIMENT IN BUTTER AND CREAM

G. F. STEWART*

*Omaha Cold Storage Company, Omaha, Nebraska*

The Research Committee of the American Association of Creamery Butter Manufacturers undertook a cooperative study of sediment testing methods for churning cream and butter some time ago. A progress report on this study was submitted to the Dairy Science Association at its annual meeting (June, 1936). Since that time the study has been completed for an entire year, and the results presented here will, therefore, cover the survey in its entirety.

Since the advent of sediment testing on a large scale in connection with the National Cream Quality Program, many tests for sediment on cream and butter have been suggested and tried. In an effort to simplify and coordinate these efforts, this study was instigated to see whether or not a test using testers, pads, and standards similar to those used for milk might be satisfactory.

Accordingly the Research Committee of the Association organized a series of studies on a nationwide scale to help toward a solution of the problem. Further, this program was discussed and met with the approval of the Associate Referee on Butter of the American Public Health Association.

The following groups of states were represented by colleges and/or commercial laboratories:

1. East—comprising New York (Buffalo and Ithaca) and Ohio (Columbus and Cincinnati).

2. Central—comprising Indiana (Frankfort and Lafayette), Illinois (Chicago, Champlain, Peoria and Danville), Iowa (Des Moines, Sioux City and Ames).

3. West-Central—including Nebraska (Omaha), Missouri (Kansas City), and Kansas (Kansas City, Topeka and Manhattan),

4. North-Central—including Michigan (Bay City), Minnesota (Duluth), and North Dakota (Fargo).

Received for publication April 2, 1937.

* Member of Research Committee of the American Association of Creamery Butter Manufacturers, Chicago, Illinois.

5. South—comprising Kentucky (Louisville) and Tennessee (Nashville).

6. Southwest—Texas (Fort Worth).

7. West—including Oregon (Portland and Corvallis) and California (Davis).

## PROCEDURE

Originally each laboratory was asked to report on three cream and two butter samples each week. A number of the collaborators gave us complete data for the entire year. However, the number of reports for the last part of our study was not as high as we had hoped for. No doubt this was due to the fact that spring and summer is the peak season for a creamery. Notwithstanding we are pleased to submit the results on 784 cream tests (three grades of cream used in each test) and 2261 butter sediment tests.

The determination of sediment in cream on each sample was made using the following methods: (1) Soda, (2) Lye, (3) Ammonia, and (4) Acid. The details were as follows:

*Cream.* A sample of cream was taken from a can of patron's cream only after it had been thoroughly stirred or mixed, using a hand agitator. After the cream had been thoroughly stirred or mixed in the patron's can, at least one quart of the cream was placed in a suitable container. The quart sample of cream was then warmed to approximately 85°–90° F. This warmed cream sample was stirred thoroughly until it poured readily, at which time two ounce portions were secured for the different testing methods. Once each week, cream samples as described above were prepared from the cream cans of three patrons. Where possible, cream of varying acidities and varying degrees of sediment were selected.

*Butter.* A sample of butter was taken from the product representative of a commercial churning. One pound of butter was used for this purpose, care being taken to obtain the same from various parts of the churn, so as to be representative. The butter samples were collected in a suitable container. The one pound sample of butter was warmed to approximately 85°–90° F., care being taken to stir the same constantly during the warming period. The warmed butter sample which had been stirred thoroughly during the warming period was divided into 100 gram portions for treatment by the different testing methods. Once every week, butter samples as described above were prepared from three different commercial churnings representing, as nearly as possible, the different grades of butter being churned.

## TESTING METHODS TO BE APPLIED TO CREAM SAMPLES

The acidity of the cream sample was determined using a nine gram sample in the titration against N/10 sodium hydroxide to the phenolphthalein endpoint. The fat content of the sample was determined by the Babcock method.

*Soda Method.* A two ounce sample of cream was placed in a graniteware container or glass beaker. Eight ounces of two per cent bicarbonate of soda solution which had been previously heated to 180° F. were then added; it was then stirred thoroughly and run through the sediment tester. The sediment tester was rinsed out with at least four ounces of hot water (185° F.). The soiled lintine discs were mounted on cardboard inserts and classified, and sealed with a metal clasp or staple in a cellophane envelope.

*Lye Method.* A two ounce sample of cream was placed in a graniteware container or glass beaker. Nine cc. acid dipper amount of one per cent lye (sodium hydroxide) solution was added; it was stirred thoroughly and allowed to stand two minutes in the cold, then four ounces hot water (185° F.) was added mixing thoroughly and run through sediment tester. Sediment tester was rinsed with at least four ounces of hot water (185° F.). The soiled lintine discs were mounted on cardboard inserts, classified, and sealed with a metal clasp or staple in a cellophane envelope.

*Ammonia Method.* A two ounce sample of cream was placed in an enamel or graniteware container or glass beaker. Eight ounces of ammonia solution (6 cc. $NH_4OH$—specific gravity 0.90 per 1000 cc. water) were added, which had previously been heated to 180° F.; it was stirred thoroughly and run through the sediment tester. The sediment tester was rinsed with at least four ounces of hot water (185° F.). The soiled lintine discs were mounted on cardboard inserts, classified and sealed with metal clasp or staple in a cellophane envelope.

*Acid Method.* A two ounce sample of cream was placed in a graniteware container or glass beaker; 200 cc. of N/20 HCl (4.5 cc. conc. HCl in 1000 cc. water) were added. The mixture was heated over a water bath to 165° F., stirring thoroughly to insure complete mixing, and run through the sediment tester. The sediment tester was rinsed with at least four ounces of hot water (185° F.). The soiled lintine discs were mounted on cardboard inserts, classified and sealed with a metal clasp or staple in a cellophane envelope.

### TESTING METHODS TO BE APPLIED TO BUTTER SAMPLES

*Hot Water Method.* A 100 gram sample of butter was placed in an enamel or graniteware container or glass beaker. Eight ounces of hot filtered water (185° F.) were then added. Then the mixture was heated on the water bath to a temperature of 165° F., stirring thoroughly to insure complete melting and mixing of the butter, and run through the sediment tester. The sediment tester was then rinsed with at least four ounces of hot water (185° F.). The soiled lintine discs were mounted on cardboard inserts, classified and sealed with a metal clasp or staple in a cellophane envelope.

*Soda Method.* A 100 gram sample of butter was put in a graniteware

container or glass beaker and eight ounces of two per cent bicarbonate of soda solution which had been previously heated to 180° F. were added. The mixture was heated on the water bath to a temperature of 165° F., stirring thoroughly to insure complete melting and mixing of the butter, and run through the sediment tester. The sediment tester was rinsed with at least four ounces of hot water (185° F.). The soiled lintine discs were mounted on cardboard inserts, classified and sealed with a metal clasp or staple in a cellophane envelope.

*Borax Method.* A 100 gram sample of butter was placed in a graniteware container or glass beaker. Eight ounces of four per cent borax solution were added. The mixture was heated over a water bath to 165° F., stirring thoroughly to insure complete melting and mixing of the butter, and run through the sediment tester. The sediment tester was rinsed with at least four ounces of hot water (185° F.). The soiled lintine discs were mounted on cardboard inserts, classified and sealed with a metal clasp or staple in a cellophane envelope.

*Acid Method.* A 100 gram sample of butter was placed in an enamel or graniteware or glass beaker container. Then 200 cc. of N/20 HCl (4.5 cc. conc. HCl in 1000 cc. water) were added to the mixture and heated over a water bath to 165° F., stirred thoroughly to insure complete mixing, and run through the sediment tester. The sediment tester was rinsed with at least four ounces of hot water (135° F.). The soiled lintine discs were mounted on cardboard inserts, classified and sealed with a metal clasp or staple in the cellophane envelope.

The sediment pads were compared with the Connecticut Official Milk Sediment Standards of 1931* to determine the relative amount of soiling. This was done both by the Association and cooperating laboratories (except for Fall 1935).

In most cases the results are shown for three grades of cream used in the particular area reporting. A division of the data on the butter samples was not possible.

## RESULTS

Table I gives the average results in the age, acidity and fat content for all the cream samples. Almost without exception, the lower the grade of the cream, the older it was, the higher its acidity, and the lower the fat content. It was further noted that there was more variation between sections in respect to acidity of number one cream than there was among the acidities of the other three grades of cream from the same section. This is taken to mean that while acidity may be used to partially determine cream grade, it cannot be used to wholly classify it. The influence of season on acidity is clearly shown also.

* Connecticut State Department of Health, Hartford, Connecticut.

TABLE I

*Age, acidity, and fat content in three grades of cream*

| DATE | NO. OF REPORTS | AGE | | | ACIDITY | | | FAT | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Grade | | | Grade | | | Grade | | |
| | | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| **Plants** | | | | | | | | | | |
| | | *days* | *days* | *days* | *per cent* | *per cent* | *per cent* | *per cent* | *per cent* | *per cent* |
| Fall 1935 | 171 | 4 | 6 | 8 | .40 | .54 | .60 | 34 | 32 | 30 |
| Winter 1936 | 204 | 4 | 5 | 6 | .39 | .50 | .61 | 33 | 33 | 32 |
| Spring 1936 | 127 | 4 | 5 | 6 | .47 | .65 | .75 | 35 | 33 | 32 |
| Summer 1936 | 90 | 4 | 5 | 6 | .68 | .76 | .94 | 35 | 34 | 33 |
| Average | 592 | 4 | 5 | 6 | .46 | .58 | .68 | 33 | 33 | 32 |
| **Colleges** | | | | | | | | | | |
| Fall 1935 | 53 | 3 | 4 | 5 | .29 | .36 | .41 | 33 | 32 | 29 |
| Winter 1936 | 72 | 3 | 4 | 5 | .24 | .34 | .45 | 35 | 32 | 33 |
| Spring 1936 | 50 | 3 | 4 | 4 | .27 | .40 | .51 | 37 | 34 | 31 |
| Summer 1936 | 17 | 1 | 1 | 1 | .14 | .19 | .29 | 33 | 32 | 34 |
| Average | 192 | 3 | 4 | 4 | .25 | .35 | .44 | 34 | 32 | 31 |
| **Combined** | | | | | | | | | | |
| Fall 1935 | 224 | 4 | 5 | 6 | .38 | .49 | .55 | 33 | 32 | 30 |
| Winter 1936 | 276 | 4 | 4 | 5 | .35 | .45 | .56 | 33 | 32 | 32 |
| Spring 1936 | 177 | 4 | 5 | 5 | .41 | .58 | .68 | 37 | 33 | 32 |
| Summer 1936 | 107 | 4 | 4 | 5 | .60 | .67 | .83 | 35 | 34 | 33 |
| Average | 784 | 4 | 5 | 6 | .41 | .52 | .63 | 33 | 33 | 32 |

TABLE II

*Filtration of cream samples using three methods, expressed as a percentage of distribution of the success secured on the different samples*

| DATE | NO. OF REPORTS | SODA | | | | | | | | | AMMONIA | | | | | | | | | ACID | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First Grade | | | Second Grade | | | Third Grade | | | First Grade | | | Second Grade | | | Third Grade | | | First Grade | | | Second Grade | | | Third Grade | | |
| | | S | SL | F | S | SL | F | S | SL | F | S | SL | F | S | SL | F | S | SL | F | S | SL | F | S | SL | F | S | SL | F |
| **Plants** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fall 1935 | 171 | 90 | 6 | 4 | 83 | 12 | 5 | 77 | 12 | 11 | 92 | 6 | 2 | 93 | 6 | 1 | 84 | 11 | 5 | 98 | 2 | 0 | 99 | 1 | 0 | 98 | 2 | 2 |
| Winter 1936 | 204 | 93 | 4 | 3 | 89 | 5 | 6 | 80 | 11 | 9 | 96 | 2 | 2 | 92 | 7 | 1 | 85 | 12 | 3 | 97 | 2 | 1 | 96 | 3 | 1 | 96 | 3 | 1 |
| Spring 1936 | 127 | 83 | 5 | 12 | 80 | 6 | 14 | 75 | 10 | 15 | 92 | 2 | 6 | 84 | 7 | 9 | 83 | 8 | 9 | 97 | 2 | 1 | 97 | 2 | 1 | 97 | 2 | 1 |
| Summer 1936 | 90 | 81 | 10 | 9 | 74 | 14 | 12 | 74 | 13 | 13 | 95 | 4 | 1 | 92 | 6 | 2 | 87 | 8 | 5 | 100 | 0 | 0 | 98 | 1 | 1 | 98 | 1 | 1 |
| Average | 592 | 88 | 6 | 6 | 83 | 9 | 8 | 76 | 12 | 12 | 94 | 4 | 2 | 91 | 6 | 3 | 85 | 10 | 5 | 98 | 1.5 | .5 | 98 | 1.5 | .5 | 97 | 2 | 1 |
| **Colleges** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fall 1935 | 53 | 90 | 8 | 2 | 92 | 8 | 0 | 81 | 15 | 4 | 89 | 9 | 2 | 77 | 19 | 4 | 77 | 17 | 6 | 96 | 4 | 0 | 98 | 2 | 0 | 92 | 8 | 0 |
| Winter 1936 | 72 | 91 | 6 | 3 | 90 | 9 | 1 | 86 | 7 | 7 | 83 | 17 | 0 | 89 | 7 | 4 | 80 | 10 | 10 | 99 | 1 | 0 | 97 | 3 | 0 | 94 | 6 | 0 |
| Spring 1936 | 50 | 80 | 18 | 2 | 84 | 6 | 10 | 78 | 12 | 10 | 86 | 10 | 4 | 82 | 16 | 2 | 62 | 26 | 12 | 98 | 2 | 0 | 100 | 0 | 0 | 98 | 0 | 2 |
| Summer 1936 | 17 | 100 | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 0 | 88 | 12 | 0 | 88 | 12 | 0 | 88 | 6 | 6 | 100 | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 0 |
| Average | 192 | 89 | 9 | 2 | 90 | 7 | 3 | 84 | 10 | 6 | 86 | 12 | 2 | 84 | 13 | 3 | 76 | 15 | 9 | 98 | 1.5 | .5 | 98 | 1.5 | .5 | 95 | 4 | 1 |
| **Combined** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fall 1935 | 224 | 90 | 7 | 3 | 85 | 11 | 4 | 79 | 13 | 8 | 91 | 7 | 2 | 89 | 9 | 2 | 83 | 11 | 6 | 98 | 2 | 0 | 99 | 1 | 0 | 96 | 4 | 0 |
| Winter 1936 | 276 | 92 | 5 | 3 | 89 | 6 | 5 | 81 | 11 | 8 | 93 | 6 | 1 | 91 | 7 | 2 | 84 | 11 | 5 | 98 | 1 | 1 | 96 | 3 | 1 | 95 | 4 | 1 |
| Spring 1936 | 177 | 81 | 9 | 10 | 81 | 6 | 13 | 76 | 11 | 13 | 91 | 4 | 5 | 83 | 9 | 8 | 77 | 13 | 10 | 97 | 2 | 1 | 97 | 2 | 1 | 97 | 1 | 2 |
| Summer 1936 | 107 | 85 | 8 | 7 | 78 | 12 | 10 | 73 | 13 | 14 | 93 | 6 | 1 | 91 | 7 | 2 | 87 | 8 | 5 | 100 | 0 | 0 | 98 | 1 | 1 | 97 | 2 | 1 |
| Average | 784 | 88 | 7 | 5 | 85 | 8 | 7 | 79 | 11 | 10 | 92 | 6 | 2 | 89 | 8 | 3 | 83 | 11 | 6 | 98 | 1.5 | .5 | 98 | 1.5 | .5 | 96 | 3 | 1 |

S—Satisfactory, SL—Slow, F—Failure.

### FILTRATION OF THE CREAM SAMPLES

In reporting results, the cooperating laboratories were asked to state whether or not filtration was (1) satisfactory, (2) slow, or (3) a failure. Table II shows the percentage of samples which fell into these three classes. As in the previous tables the data are separated by grade and season. Due to the poor showing of the lye method during the fall period, it was dropped from the study. The data were separated by section also, but there were no essential difference, and to conserve space, this comparison has been omitted from this paper. The table clearly shows the following order is taken by the different methods in respect to the percentage of successful filtrations.

(1) Acid—grand average ..... 98%
(2) Ammonia—grand average ..... 88%
(3) Soda—grand average ..... 84%
(4) Lye—grand average ..... 61% (fall only)

It is also very evident, that except for the acid method, the lower grades of cream filtered more poorly. The acid method was highly successful on all grades of cream, in all territories, and at all seasons.

Aside from the acid method the methods worked with different degrees of success in the different sections. For instance, the college group found the ammonia method less satisfactory than the soda method, whereas the opposite is true of the commercial laboratories. Aside from differences in the cream, no doubt, "getting used to the method" played an important part in making one or another of the methods more successful. In other words, the acid method was more foolproof than the ammonia or soda procedures.

### SCORING OF THE SEDIMENT PADS

Table III shows the average sediment scores for the cream samples separated as to grade, season, place of grading, and method of testing. As stated previously, the figures were obtained by comparing the sediment discs directly with the Connecticut Standards. Here again the lack of space, and due to the fact that there was little or no sectional influences, distribution of the data by sections has been eliminated.

The results show quite definitely that the lower the grade of cream, the higher the sediment score. The shift with grade does not, however, represent the difference between two discs on the Standard Chart. The acid method produced the cleaner pads while the soda and ammonia methods produced pads about equally clean. Careful observation on this point has revealed that this difference in degree of soiling was in all probability due to the presence or absence of undissolved curd or curd-solvent scum, rather than any real differences in the amount of dirt.

Another interesting point is to be derived from these data. The plant laboratories tended to score their sediment pads cleaner than did the Asso-

TABLE III

*Average scores cream sediment pads using three methods*

| DATE | NO. OF REPORTS | SODA | | | | | | AMMONIA | | | | | | ACID | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Association | | | Plant | | | Association | | | Plant | | | Association | | | Plant | | |
| | | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| **Plants** | | | | | | | | | | | | | | | | | | | |
| Fall 1935 | 171 | 28 | 37 | 43 | ..... | ..... | ..... | 29 | 39 | 51 | ..... | ..... | ..... | 25 | 32 | 41 | ..... | ..... | ..... |
| Winter 1936 | 204 | 22 | 25 | 30 | 17 | 19 | 24 | 26 | 33 | 38 | 17 | 23 | 31 | 18 | 21 | 28 | 12 | 14 | 26 |
| Spring 1936 | 127 | 36 | 37 | 33 | 31 | 34 | 35 | 38 | 41 | 42 | 35 | 36 | 36 | 23 | 29 | 33 | 27 | 29 | 33 |
| Summer 1936 | 90 | 39 | 34 | 38 | 40 | 37 | 42 | 36 | 26 | 46 | 41 | 37 | 46 | 32 | 34 | 42 | 37 | 39 | 43 |
| Average ..... | 592 | 29 | 34 | 37 | 25 | 27 | 32 | 31 | 35 | 43 | 27 | 30 | 35 | 23 | 28 | 35 | 21 | 24 | 29 |
| **Colleges** | | | | | | | | | | | | | | | | | | | |
| Fall 1935 | 53 | 21 | 21 | 26 | ..... | ..... | ..... | 15 | 22 | 25 | ..... | ..... | ..... | 10 | 16 | 13 | ..... | ..... | ..... |
| Winter 1936 | 72 | 8 | 9 | 8 | 10 | 10 | 11 | 4 | 6 | 9 | 8 | 7 | 9 | 2 | 7 | 10 | 7 | 5 | 8 |
| Spring 1936 | 50 | 11 | 12 | 13 | 17 | 17 | 18 | 17 | 16 | 15 | 18 | 21 | 19 | 10 | 11 | 13 | 14 | 20 | 16 |
| Summer 1936 | 17 | 16 | 15 | 12 | ..... | ..... | ..... | 13 | 16 | 18 | ..... | ..... | ..... | 9 | 10 | 12 | ..... | ..... | ..... |
| Average ..... | 192 | 13 | 13 | 15 | 13 | 13 | 14 | 11 | 14 | 16 | 12 | 13 | 13 | 7 | 11 | 12 | 10 | 11 | 11 |
| **Combined** | | | | | | | | | | | | | | | | | | | |
| Fall 1935 | 224 | 26 | 33 | 38 | ..... | ..... | ..... | 20 | 30 | 39 | ..... | ..... | ..... | 21 | 28 | 34 | ..... | ..... | ..... |
| Winter 1936 | 276 | 18 | 21 | 25 | 14 | 16 | 21 | 19 | 25 | 29 | 14 | 16 | 22 | 14 | 18 | 23 | 11 | 12 | 16 |
| Spring 1936 | 177 | 28 | 29 | 27 | 29 | 31 | 32 | 29 | 31 | 33 | 29 | 32 | 30 | 20 | 24 | 28 | 25 | 27 | 30 |
| Summer 1936 | 107 | 35 | 31 | 37 | ..... | ..... | ..... | 32 | 30 | 41 | ..... | ..... | ..... | 28 | 29 | 36 | ..... | ..... | ..... |
| Average ..... | 748 | 25 | 27 | 29 | 21 | 24 | 27 | 26 | 29 | 36 | 25 | 26 | 31 | 20 | 24 | 28 | 19 | 21 | 25 |

ciation laboratory. This was, no doubt, due to more strict observation of the pads by the latter.

TABLE IV

*Filtration rate of butter samples using four methods, expressed as a percentage distribution of the success secured on the different samples*

| DATE | NO. OF REPORTS | HOT WATER | | | SODA | | | BORAX | | | ACID | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S | SL | F | S | SL | F | S | SL | F | S | SL | F |
| **Plants** | | | | | | | | | | | | | |
| Fall 1935 | 490 | 91 | 6 | 3 | 86 | 10 | 4 | 67 | 22 | 11 | 90 | 8 | 2 |
| Winter 1936 | 576 | 94 | 5 | 1 | 93 | 5 | 2 | 82 | 13 | 5 | 94 | 5 | 1 |
| Spring 1936 | 370 | 90 | 4 | 6 | 85 | 8 | 7 | 77 | 10 | 13 | 90 | 10 | 0 |
| Summer 1936 | 276 | 86 | 4 | 10 | 81 | 9 | 10 | 57 | 25 | 18 | 90 | 5 | 5 |
| Average | 1712 | 91 | 5 | 4 | 87 | 8 | 5 | 69 | 18 | 13 | 92 | 6 | 2 |
| **Colleges** | | | | | | | | | | | | | |
| Fall 1935 | 149 | 81 | 18 | 1 | 80 | 16 | 4 | 56 | 28 | 16 | 92 | 5 | 3 |
| Winter 1936 | 215 | 87 | 12 | 1 | 91 | 9 | 0 | 76 | 17 | 7 | 98 | 1 | 1 |
| Spring 1936 | 144 | 82 | 17 | 1 | 87 | 12 | 1 | 74 | 24 | 2 | 95 | 4 | 1 |
| Summer 1936 | 41 | 90 | 5 | 5 | 68 | 27 | 5 | 39 | 22 | 39 | 100 | 0 | 0 |
| Average | 549 | 88 | 11 | 1 | 86 | 13 | 1 | 67 | 23 | 10 | 95 | 3 | 2 |
| **Combined** | | | | | | | | | | | | | |
| Fall 1935 | 639 | 89 | 9 | 2 | 85 | 11 | 4 | 64 | 24 | 12 | 91 | 7 | 2 |
| Winter 1936 | 791 | 92 | 7 | 1 | 92 | 6 | 2 | 80 | 14 | 6 | 95 | 4 | 1 |
| Spring 1936 | 514 | 88 | 8 | 4 | 86 | 9 | 5 | 76 | 14 | 10 | 95 | 2 | 3 |
| Summer 1936 | 317 | 87 | 4 | 9 | 79 | 11 | 10 | 55 | 25 | 20 | 91 | 5 | 4 |
| Average | 2261 | 90 | 6 | 4 | 87 | 9 | 4 | 70 | 18 | 12 | 93 | 5 | 2 |

S—Satisfactory, SL—Slow, F—Failure.

### BUTTER SEDIMENT TESTS

The results of the sediment tests on butter are shown in Table IV. Surprising though it may seem, the hot water method rated close to the acid method in the percentage of successful filtrations. The soda method also proved quite satisfactory most of the year. The borax method was least desirable from this point of view, being particularly poor in the summer and fall months of the year. The grand average percentage of successful filtrations were as follows:

(1) Acid ..... 93%
(2) Hot Water ..... 90%
(3) Soda ..... 87%
(4) Borax ..... 70%

### SCORING BUTTER SEDIMENT PADS

Table V shows the scores for the butter sediment pads. Except for the fall period the pads were scored both in Chicago and at the plant or college laboratory.

TABLE V

*Average scores on butter sediment pads*

| DATE | NO. OF REPORTS | HOT WATER | | SODA | | BORAX | | ACID | |
|---|---|---|---|---|---|---|---|---|---|
| | | Assn. | Plants | Assn. | Plants | Assn. | Plants | Assn. | Plant |
| **Plants** | | | | | | | | | |
| Fall 1935 | 490 | 34 | ..... | 40 | ..... | 49 | ..... | 36 | ..... |
| Winter 1936 | 576 | 27 | 14 | 32 | 17 | 39 | 20 | 27 | 16 |
| Spring 1936 | 370 | 33 | 32 | 36 | 32 | 41 | 34 | 32 | 38 |
| Summer 1936 | 276 | 36 | 38 | 40 | 43 | 50 | 52 | 35 | 40 |
| Average .. | 1712 | 32 | 25 | 37 | 29 | 44 | 32 | 32 | 25 |
| **Colleges** | | | | | | | | | |
| Fall 1935 | 149 | 27 | ..... | 33 | ..... | 39 | ..... | 26 | ..... |
| Winter 1936 | 215 | 16 | 14 | 20 | 12 | 18 | 16 | 17 | 13 |
| Spring 1936 | 144 | 20 | 12 | 21 | 15 | 29 | 18 | 20 | 14 |
| Summer 1936 | 41 | 24 | 27 | 25 | 30 | 31 | 33 | 26 | 28 |
| Average .. | 549 | 21 | 15 | 25 | 21 | 27 | 23 | 21 | 16 |
| **Combined** | | | | | | | | | |
| Fall 1935 | 639 | 33 | ..... | 39 | ..... | 47 | ..... | 34 | ..... |
| Winter 1936 | 791 | 24 | 14 | 28 | 18 | 34 | 18 | 24 | 15 |
| Spring 1936 | 514 | 29 | 26 | 32 | 28 | 38 | 28 | 28 | 25 |
| Summer 1936 | 317 | 34 | 37 | 38 | 45 | 49 | 56 | 33 | 38 |
| Average .. | 2261 | 29 | 22 | 34 | 27 | 40 | 31 | 29 | 23 |

The degrees of soiling were very closely related to the ease of filtering; the borax filter pads had the highest scores. The hot water and acid methods provided the cleanest pads. Although the differences are not great they are, no doubt, significant. Naturally, the explanation follows the same line as that given for the cream sediment pads. Further work must be pursued in order to establish the point, however.

## SUMMARY

The results of this investigation indicate that:

1. Cream and butter are most satisfactorily tested for sediment using the acid method. The lye method for cream and the borax method for butter proved to give a great number of unsatisfactory filtrations and were therefore impracticable for routine work.

2. The standard lintine discs and sediment testers used for milk were satisfactorily used in these tests.

3. The Connecticut Official Milk Sediment Standards, 1931, may be used for interpretation of results.

4. Indications were established showing that undissolved curd or curd-solvent scum caused pads to appear dirtier with certain curd solvents than with those which produced no such residue.

The author wishes to express his appreciation to all those who were so generous in cooperating to make this study possible. The laboratories of the creameries as well as the colleges gave generously of their time and materials. Particularly is the author indebted to the American Association of Creamery Butter Manufacturers' Research Committee under whose direction this entire project was fostered and carried out. Mr. Brown of the Association's laboratory is to be also especially thanked for his great expense of extra time and energy in helping with the tabulation of this data. Without the help of all of these people the venture would not have materialized.

# THE EFFECT OF BREED CHARACTERISTICS AND THE PLANE OF NUTRITION OF THE COW ON THE VITAMIN A POTENCY OF MILK*

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The natural pigmentation of milk produced by various breeds of dairy cattle under comparable conditions is known to vary with different breeds. The Guernsey and the Jersey breeds produce a more highly pigmented milk than do the cows of the Holstein, Ayrshire, and Brown Swiss breeds. This yellow color is restricted almost entirely to the milk fat and is due primarily to carotene. Since carotene is now recognized as a precursor of vitamin A, it would seem logical to postulate that butter made from Guernsey or Jersey milk should possess greater vitamin A potency than butter made from the milk of the Holstein, the Ayrshire, or the Brown Swiss breeds. Furthermore, Jersey and Guernsey milks, in addition to having a higher color value, also have a higher average fat content. In view of these facts, it would appear that there should be a difference in the vitamin A potency of these milks, especially if carotene alone is responsible for this biological activity. Milk fat, however, does not owe all of its vitamin A activity to carotene. Morton and Heilbron (1) have demonstrated by spectographic analysis that milk fat contains both carotene and vitamin A. Moore (2) has likewise demonstrated that milk fat contains both carotene and vitamin A and that cows convert carotene into vitamin A.

Davis and Hathaway (3) studied the vitamin A potency of milk from Holstein, Jersey, Ayrshire, and Guernsey cows, and concluded that there was no significant difference in the vitamin A content of these milks. Hathaway and Davis (4) reported that Holstein cream contained more vitamin A than Jersey cream. Wilbur, Hilton and Hauge (5) made a comparison of the vitamin A activity of butters from one group of Ayrshire and two groups of Guernsey cows fed under identical conditions. As the result of these studies they concluded that the vitamin A activity of the samples of butter were similar, regardless of the breed of cows or the color of butter. Sutton and Krauss (6) of the Ohio Station concluded that Hol-

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stein milk fat had a greater vitamin A potency per unit weight than did Guernsey milk fat, in spite of the fact that the Guernsey milk fat was richer in carotene. Booth, Kon and Gillam (7) compared the vitamin A activity of Shorthorn and Guernsey butters produced from cows kept under comparable conditions of feeding and management. These butters were found to be identical in vitamin A activity. Baumann *et al.* (8) made a study of the influence of breed and diet of cows on carotene and vitamin A content of the butter produced. These investigators used spectroscopic methods for determining carotene and vitamin A, and reported definite breed differences when the cows received high and low carotene diets. However, when total biological activity of the several butters were calculated, they found this breed difference to be small.

It is clearly evident that the data presented in the foregoing literature are not in complete agreement with regard to several pertinent points. It is therefore obvious that additional information on a number of these points would be of material value.

The present investigation was undertaken in order to obtain further data concerning the effect of breed characteristics and the plane of nutrition of the cow on the vitamin A potency of milk.

## EXPERIMENTAL PROCEDURE

The present investigation may be regarded as consisting of four distinct phases, viz.

I. The vitamin A potency of milks from cows representing breeds that normally produce highly pigmented and poorly pigmented milks when fed a good ration similar to those commonly employed in commercial feeding practice.

II. The vitamin A potency of milks from cows as in I, but fed a pigment poor ration.

III. The vitamin A potency of milks from cows as in II when large daily doses of commercial carotene were included in the ration.

IV. The vitamin A potency of milks produced by five standard dairy breeds under identical feeding conditions.

The cows selected for each phase of this study were true representatives of the respective breeds and the stages of lactation and gestation were as nearly identical as possible. The cows were milked the same number of times daily, were treated as nearly alike as possible and were maintained in individual stalls so constructed that access to food substances other than those intended for the particuar animals was not possible. Each animal received, daily, an accurately weighed quantity of ration in the form of a grain mixture and roughage. An aliquot portion of the milk produced at each of the three milkings during the twenty-four hour period was fed the same day to test rats, in the usual manner, in order to determine its vitamin

A potency. This procedure was followed in studying each phase, with minor modifications which will be mentioned later.

## PRESENTATION OF DATA

*I. The vitamin A potency of milks from cows representing breeds that normally produce highly pigmented and poorly pigmented milks when fed a good ration similar to those commonly employed in commercial feeding practice*

In the first phase of the investigation an attempt was made to determine the vitamin A content of milks from Guernsey and Holstein cows which were fed a good dairy ration that is commonly fed in commercial feeding practice. For this phase of the study two groups of cows (two Holstein and two Guernseys in each group) were selected from the experiment station herd as experimental subjects.

The four cows in Group I were placed on a diet composed of a good quality dehydrated clover hay and a grain mixture (300 parts corn and cob meal, 200 parts of oat feed, 250 parts barley feed, 50 parts distillers' grain, 125 parts cottonseed meal, and 50 parts gluten feed) which was the usual ration fed to the test cows in the station herd. The cows received this diet for one month previous to the test period. The purpose of this preliminary feeding period was to give the cows sufficient time to start producing milk uniform in vitamin A.

Although the rat data were fairly conclusive as to the vitamin A potency of the milk produced by the four cows, it was deemed advisable to repeat the experiment in order to have more conclusive data. For this purpose other Holsteins and Guernseys were used. These cows received the same basal diet and roughage and were handled in the same manner as the cows in the previous experiment.

Tables I and II present the vitamin A potencies of milks produced by representative Guernsey and Holstein cows while receiving a normal dairy ration.

Table II shows the average vitamin A potencies of milks produced by a second series of Guernsey and Holstein cows receiving a normal dairy ration.

From the data presented in Tables I and II, it is quite evident that equal volumes of milk from cows of different breeds receiving a normal dairy ration are not equally potent in vitamin A as reported by Davis and Hathaway (3). There appears also to be a wide difference in the vitamin A potency of milks produced by different cows of the same breed. The milks from Holstein cows Nos. 1709 and 1711 were very low in vitamin A as compared with the milk from Guernsey cow No. 1673 and Holstein cow No. 1489. The rats receiving 0.6 cc. of milk from cows Nos. 1709 and 1711 were unable to maintain their body weights, while the rats receiving a like amount of milks from cows Nos. 1673 and 1489 made an average gain of 31 and 34

TABLE I

*The vitamin A potencies of milks produced by representative Guernsey and Holstein cows receiving a normal dairy ration*

| COW NO. | BREED | NUMBER OF RATS | AMOUNT MILK FED CC. | AVERAGE WEIGHT OF RATS AT END OF DEPLETION PERIOD GMS. | AVERAGE WEIGHT OF RATS AT END OF EXPERIMENT GMS. | AVERAGE GAIN IN WEIGHT GMS. | AVERAGE DAILY GAIN PER GRAM MILK FED | APPROXIMATE VITAMIN A UNITS PER QUART (SHERMAN) |
|---|---|---|---|---|---|---|---|---|
| 1453 | Holstein | 2 | 0.4 | 69 | 66 | −3 | | |
| 1453 | Holstein | 4 | 0.6 | 83 | 97 | 14 | 0.617 | 1447 |
| 1453 | Holstein | 5 | 0.8 | 79 | 107 | 28 | | |
| 1489 | Holstein | 3 | 0.4 | 84 | 84 | 0 | | |
| 1489 | Holstein | 3 | 0.6 | 85 | 119 | 34 | 1.07 | 3511 |
| 1489 | Holstein | 5 | 0.8 | 72 | 106 | 34 | | |
| 1571 | Guernsey | 2 | 0.4 | 78 | 77 | −1 | | |
| 1571 | Guernsey | 5 | 0.6 | 74 | 100 | 26 | 0.902 | 2620 |
| 1571 | Guernsey | 5 | 0.8 | 79 | 104 | 25 | | |
| 1673 | Guernsey | 1 | 0.4 | 78 | 88 | 10 | | |
| 1673 | Guernsey | 4 | 0.6 | 77 | 108 | 31 | 1.24 | 3203 |
| 1673 | Guernsey | 5 | 0.8 | 78 | 123 | 45 | | |

TABLE II

*The average vitamin A potencies of milks produced by a second group of Guernsey and Holstein cows receiving a normal dairy ration*

| COW NO. | BREED | NUMBER OF RATS | AMOUNT MILK FED CC. | AVERAGE WEIGHT OF RATS AT END OF DEPLETION PERIOD GMS. | AVERAGE WEIGHT OF RATS AT END OF EXPERIMENT GMS. | AVERAGE GAIN IN WEIGHT GMS. | AVERAGE DAILY GAIN PER GRAM MILK FED | APPROXIMATE VITAMIN A UNITS PER QUART (SHERMAN) |
|---|---|---|---|---|---|---|---|---|
| 1709 | Holstein | 6 | 0.5 | 127 | 124 | − 3 | | |
| 1709 | Holstein | 2 | 0.6 | 141 | 130 | −11 | | |
| 1711 | Holstein | 4 | 0.5 | 121 | 105 | −16 | | |
| 1711 | Holstein | 5 | 0.6 | 95 | 90 | − 5 | | |
| 1546 | Guernsey | 5 | 0.5 | 128 | 150 | 22 | 1.22 | 1868 |
| 1546 | Guernsey | 4 | 0.6 | 120 | 145 | 25 | | |
| 1548 | Guernsey | 6 | 0.5 | 128 | 128 | 0 | | |
| 1548 | Guernsey | 4 | 0.6 | 115 | 134 | 19 | 0.50 | 1550 |

grams respectively during the experimental period. Holstein cow No. 1453 and Guernsey cows Nos. 1546 and 1548 produced milks containing about the same amounts of vitamin A. The vitamin A potency per unit volume of these milks was midway between the two extremes mentioned above. Wilber, Hilton and Hauge (5) stated that under similar feeding conditions the higher the percentage of fat in the milk, the greater was its vitamin A potency. The data presented herein are not in complete agreement with the above findings, as some cows produced milk of the same fat content and were found to differ considerably in vitamin A potency. In our study the vitamin A potency of the milk of individual cows was determined, whereas the vitamin A potency of the pooled milk from groups of cows was determined by the above mentioned investigators. If, however, the average vitamin A potency of the milk of the four cows from each breed is considered, the results are in close agreement with those of Wilbur and associates.

*II. The vitamin A potency of milks from cows representing breeds that normally produce pigment rich and pigment poor milks, the ration fed to all cows being of pigment poor quality*

The cows used in the latter part of the former experiment were also used for this phase of this investigation. After receiving a normal dairy ration for two months, these cows were fed a pigment poor ration. This ration consisted of a grain mixture, timothy hay of very poor quality and dried beet pulp. The grain mixture (300 parts bran, 200 parts oats, 200 parts barley, 100 parts linseed meal, 100 parts cottonseed meal, and 9 parts salt) was fed in amounts proportionate to the milk production. Twelve pounds of timothy hay of poor grade were fed to each cow daily. The Holstein cows received eight pounds of dry beet pulp daily, while the Guernseys received but six pounds daily. The cows received this diet from November, 1933, until June, 1934. After seven months, the cows were in poor physical condition, had lost weight, had declined in milk production, and had manifested marked symptoms of diarrhea. Five attempts were made during this seven-month period to determine the vitamin A potency of the milks from each of the four cows. The estimated amount of milk necessary to induce unit gain in weight was calculated at the beginning of each succeeding determination with the aid of the data previously established. These estimations were difficult to make, for at the time the experiment was being carried out no data were available to indicate the rapidity of depletion or the amount of time required to deplete the cows of their body stores of vitamin A. As a result, a number of these estimations proved to be low, and the rats receiving such quantities of milk were unable to maintain their body weights. In the last weeks of the experiment sufficient data had been collected, however, to make it possible to estimate more accurately the volume of milk necessary to induce unit gain. Table III presents a summary of the biological data

obtained while testing the milk from these cows which received a pigment-poor ration. During this phase of the work, many of the levels chosen proved to be too low, with the result that many of the rats on such levels died before the end of the curative period. The data from those rats which made significant responses are included in this table. The table contains a summary of the growth responses of only 130 rats, although 250 rats were used in this phase of the study.

The data in Table III show that Guernsey cow No. 1546 produced milk containing the highest vitamin A potency per unit volume. Holstein cow No. 1711, on the other hand, produced milk with the lowest vitamin A potency. It is also evident that the milk from the two Guernsey cows was richer in vitamin A than the milk of the two Holstein cows. The milk from Guernsey cow No. 1546 contained approximately 1550 units per quart at the beginning of the depletion period and 513 units at the end of the depletion period. This reduction in vitamin A represents approximately 66 per cent of the total. Likewise, milk from Guernsey cow No. 1548 contained 1550 units of vitamin A at the beginning of the depletion period and less than 405 units at the end of the seven months' period. This represents a decrease of approximately 73 per cent of the total vitamin A potency.

It is impossible from the data obtained to calculate the vitamin A potency of the milks from Holstein cows Nos. 1709 and 1711 at the beginning of the depletion period. However, it may be assumed that it contained approximately 900 units per quart in the beginning. The data obtained show that they contained an average of 255 units per quart at the end of the depletion period. If the above assumption is correct, the milks from the two Holstein cows lost 70 per cent of their original vitamin A potency during the seven months' period on a pigment-poor diet. This reduction in vitamin A potency is approximately the same as that found with the Guernsey milks. The data indicate that the rate of decrease in total vitamin A potency of milks produced under these adverse feeding conditions was about the same for the two breeds studied.

The foregoing results agree with those reported by Fraps, Copeland and Treichler (10). These investigators reported that the milks which they tested contained from 33 to 38 Sherman units of vitamin A per gram of fat in the beginning and from 5 to 12 units after the cows had been on a pigment-poor diet for five months. Gillam and coworkers (9) in England found that in the case of cows receiving a normal winter ration of hay and concentrates, the vitamin A potency of butter fell from approximately 16 International units of vitamin A per gram in the beginning to approximately 5 units at the end of six months. This represents a reduction of approximately 68 per cent, a result which compares favorably with that obtained in these studies.

These results are in agreement with those reported in Tables I and II

TABLE III

*Results obtained in a progressive series of vitamin A assays made on milks produced by representative Guernsey and Holstein cows receiving a pigment poor ration*

| PERIOD | BREED | COW NO. | NUMBER OF RATS | DOSE CC. | AVERAGE WEIGHT OF RATS AT END OF DEPLETION PERIOD GMS. | AVERAGE WEIGHT OF RATS AT END OF EXPERIMENT GMS. | AVERAGE GAIN IN WEIGHT GMS. | AVERAGE DAILY GAIN PER GRAM MILK FED | APPROXIMATE VITAMIN A UNITS PER QUART (SHERMAN) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Less than |
| 11/25 to 12/30 | Guernsey | 1546 | 5 | 0.6 | 115.2 | 122.8 | 7.6 | .36 | 1550 |
| 12/19 to 1/23 | Guernsey | 1546 | 4 | 0.6 | 150.5 | 150.5 | 0.0 | | |
| 12/19 to 1/23 | Guernsey | 1546 | 3 | 0.8 | 114.0 | 131.3 | 17.3 | .62 | 1167 |
| 3/25 to 4/29 | Guernsey | 1546 | 3 | 1.0 | 118.3 | 138.0 | 19.7 | .56 | 934 |
| 3/25 to 4/29 | Guernsey | 1546 | 3 | 1.3 | 104.0 | 132.6 | 28.6 | .62 | 710 |
| 3/25 to 4/29 | Guernsey | 1546 | 4 | 1.6 | 117.8 | 138.7 | 21.0 | .37 | 551 |
| 4/15 to 5/29 | Guernsey | 1546 | 5 | 1.6 | 67.2 | 80.0 | 12.8 | | |
| 6/ 9 to 6/13 | Guernsey | 1546 | 7 | 1.8 | 104.4 | 125.0 | 20.6 | .32 | 513 |
| 11/25 to 12/30 | Guernsey | 1548 | 5 | 0.6 | 114.6 | 104.8 | 9.8 | | |
| 12/19 to 1/23 | Guernsey | 1548 | 4 | 0.6 | 108.0 | 118.5 | 10.5 | .49 | 1550 |
| 3/25 to 4/29 | Guernsey | 1548 | 4 | 1.0 | 115.7 | 109.0 | −6.7 | | |
| 3/25 to 4/29 | Guernsey | 1548 | 4 | 1.3 | 117.7 | 121.5 | 3.7 | | |
| 3/25 to 4/29 | Guernsey | 1548 | 4 | 1.6 | 113.2 | 122.5 | 9.2 | | |
| 4/12 to 5/29 | Guernsey | 1548 | 5 | 2.0 | 73.0 | 85.4 | 12.4 | .17 | 467 |
| | | | | | | | | | Less than |
| 6/ 9 to 6/13 | Guernsey | 1548 | 9 | 2.3 | 102.6 | 108.7 | 6.1 | .08 | 405 |

TABLE III—(*Continued*)

| PERIOD | BREED | COW NO. | NUMBER OF RATS | DOSE CC. | AVERAGE WEIGHT OF RATS AT END OF DEPLETION PERIOL GMS. | AVERAGE WEIGHT OF RATS AT END OF EXPERIMENT GMS. | AVERAGE GAIN IN WEIGHT GMS. | AVERAGE DAILY GAIN PER GRAM MILK FED | APPROXIMATE VITAMIN A UNITS PER QUART (SHERMAN) |
|---|---|---|---|---|---|---|---|---|---|
| 11/25 to 12/30 | Holstein | 1709 | 4 | 0.8 | 111.2 | 111.0 | −0.2 | | 900 |
| 12/19 to 1/23 | Holstein | 1709 | 4 | 0.8 | 111.5 | 100.2 | −11.3 | | |
| 3/25 to 4/29 | Holstein | 1709 | 2 | 1.0 | 110.0 | 95.5 | −14.5 | | |
| 3/25 to 4/29 | Holstein | 1709 | 4 | 1.3 | 122.2 | 124.5 | 2.3 | | |
| 3/25 to 4/29 | Holstein | 1709 | 4 | 1.6 | 112.5 | 115.7 | 3.2 | | |
| 4/15 to 5/29 | Holstein | 1709 | 4 | 2.0 | 73.5 | 75.7 | 2.2 | | |
| 6/ 9 to 6/13 | Holstein | 1709 | 9 | 3.5 | 107.6 | 124.3 | 16.7 | .13 | 266 |
| 11/25 to 12/30 | Holstein | 1711 | 4 | 0.8 | 101.7 | 91.2 | −10.5 | | 900 |
| 12/19 to 1/23 | Holstein | 1711 | 3 | 0.8 | 127.6 | 113.6 | −14.0 | | |
| 12/19 to 1/23 | Holstein | 1711 | 3 | 1.0 | 100.6 | 87.3 | −13.3 | | |
| 3/25 to 4/29 | Holstein | 1711 | 4 | 1.0 | 102.5 | 81.0 | −21.3 | | |
| 3/25 to 4/29 | Holstein | 1711 | 4 | 1.3 | 107.7 | 110.5 | 2.8 | | |
| 3/25 to 4/29 | Holstein | 1711 | 4 | 1.6 | 106.5 | 106.3 | −0.2 | | |
| 4/15 to 5/29 | Holstein | 1711 | 2 | 2.0 | 67.0 | 71.0 | 4.0 | | |
| 6/ 9 to 6/13 | Holstein | 1711 | 6 | 3.8 | 109.0 | 124.6 | 15.6 | .12 | 245 |

of the present study, namely, that Guernsey milk contains more vitamin A per unit volume than Holstein milk.

*III. The vitamin A potency of milks from cows representing breeds that normally produce pigment-rich and pigment-poor milks, the ration fed to all cows being pigment-poor but highly fortified with a commercial carotene preparation*

The cows used in the previous experiment that had been depleted of their body stores of vitamin A were also used for this study. It was planned to feed daily 150,000 A.D.M.A. units of vitamin A in the form of carotene to each of the depleted cows for a period of twelve days. A twelve-day feeding period was subdivided into three equal periods and a biological study for increased vitamin A potency was made on aliquot portions of the milk produced during each of these periods. All the milk from each of the four cows was collected and kept in ice water for four days, after which it was pooled. Approximately 80 cc. portions of the composited milks were placed in individual cardboard containers and these in turn were placed in a cold room at – 15° F. where they were frozen and stored until used. The milks from the last four days of the depletion period were also collected and stored in the same manner. As the milks were needed for the biological assays they were removed from cold storage and allowed to thaw at room temperature, previous to feeding.

The four depleted cows were fed daily carotene equivalent to 150,000 units of vitamin A for a twelve-day period. This carotene was supplied to each animal by feeding 51 cc. of a commercial carotene preparation which contained 3,000 A.D.M.A. units of vitamin A per gram.* This amount of carotene was considered sufficient to cause the cows to regain their body stores of carotene and to secrete milk of at least normal vitamin A potency by the end of the twelve-day period. The twelve days were divided into three periods to study (by the biological response method) any increase in vitamin A potency of the pooled milks during these successive collection periods. The method of sampling and preserving of the milks is described above. Since it was necessary to know the vitamin A potency of the milks before the carotene feeding began, the milk from the last four days of the depletion period was collected and pooled.

Table IV presents a summary of the biological assay data collected. It is evident from these data that 150,000 A.D.M.A. units of vitamin A in the form of carotene per cow per day for a twelve-day period did not bring about the expected increase in vitamin A potency. It is probable that a twelve-day period is insufficient time for the cows to secrete milk of normal vitamin A potency under such feeding conditions. Three of the four cows used in this study seemed to give the same response to intensive carotene

* The commercial carotene was supplied gratis by the S.M.A. Corporation, Cleveland, Ohio.

TABLE IV

*Summarizing the results of a progressive series of vitamin A assays made on milks produced by representative Guernsey and Holstein cows after being changed from a pigment poor ration to a pigment rich ration*

| CAROTENE FEEDING PERIOD | COW NO. | NUMBER OF RATS | DOSE CC. | AVERAGE WEIGHT OF RATS AT END OF DEPLETION PERIOD GMS. | AVERAGE WEIGHT OF RATS AT END OF EXPERIMENT GMS. | GAIN IN WEIGHT GMS. | APPROXIMATE VITAMIN A UNITS PER QUART (SHERMAN) |
|---|---|---|---|---|---|---|---|
| Last 4 days of depletion period | 1546 | 7 | 1.8 | 104.4 | 125.0 | 20.6 | |
| First 4 days carotene feeding | 1546 | 9 | 1.8 | 81.3 | 101.2 | 19.9 | 450 |
| Second 4 days carotene feeding | 1546 | 7 | 1.8 | 82.0 | 107.2 | 25.2 | |
| Third 4 days carotene feeding | 1546 | 6 | 1.8 | 98.6 | 127.5 | 28.9 | |
| Last 4 days of depletion period | 1548 | 9 | 2.3 | 102.6 | 108.7 | 6.1 | |
| First 4 days carotene feeding | 1548 | 10 | 2.3 | 78.1 | 97.3 | 19.1 | 400 |
| Second 4 days carotene feeding | 1548 | 7 | 2.3 | 90.6 | 109.7 | 18.8 | |
| Third 4 days carotene feeding | 1548 | 5 | 2.3 | 85.8 | 103.4 | 17.6 | |
| Last 4 days of depletion period | 1709 | 9 | 3.5 | 107.6 | 124.3 | 16.7 | |
| First 4 days carotene feeding | 1709 | 5 | 3.5 | 82.6 | 88.4 | 5.8 | 260 |
| Second 4 days carotene feeding | 1709 | 4 | 3.5 | 89.7 | 90.2 | 0.5 | |
| Third 4 days carotene feeding | 1709 | 4 | 3.5 | 89.0 | 103.7 | 14.7 | |
| Last 4 days of depletion period | 1711 | 6 | 3.8 | 109.0 | 124.6 | 15.6 | |
| First 4 days carotene feeding | 1711 | 6 | 3.8 | 92.8 | 111.0 | 18.1 | 240 |
| Second 4 days carotene feeding | 1711 | 4 | 3.8 | 81.0 | 96.5 | 15.5 | |
| Third 4 days carotene feeding | 1711 | 7 | 3.8 | 88.5 | 105.7 | 17.2 | |

feeding since there was a very slight increase in the vitamin A potency of their milks. The milk from Holstein cow No. 1709 during periods II and III actually showed a decrease in vitamin A content.

A wide difference in vitamin A potency is noted between the four milks studied. The milk from cow No. 1546 contained the greatest amount of

vitamin A, approximately 453 units per quart, while the milks from cows Nos. 1548, 1709, and 1711 contained approximately 401, 261, and 242 vitamin A units per quart, respectively.

The data obtained in the above studies agree with the findings of Fraps and coworkers (10), who reported that the feeding of 116,000 rat units (?) of vitamin A per day is not sufficient to maintain the vitamin A potency of butterfat. Baumann and Steenbock (8) reported that the feeding of 50 to 60 pounds of freshly cut green alfalfa daily caused the carotene and the vitamin A content of the butterfat to increase rapidly. This alfalfa contained approximately 1,000,000 (?) units of vitamin A and caused the milk to contain maximum values for both carotene and vitamin A within a two weeks' period. A paper by Loy, Hilton, Wilbur and Hauge (11) appeared just subsequent to the preparation of this manuscript. These authors draw the conclusion that it takes from 10 to 11 days for the milk fat of the cow to reach its vitamin A equilibrium when the animal is shifted from a vitamin A rich diet to a vitamin A poor diet, and vice versa. With these conclusions in mind, the data of the present study would seem to indicate that 150,000 A.D.M.A. units per day were only sufficient to maintain constant the vitamin A potency of milks of cows receiving a pigment poor diet. If these cows had been fed this amount of carotene for a longer period of time, milk with a higher vitamin A potency might have been produced.

### *IV. The vitamin A potency of milks produced by five standard dairy breeds under identical feeding conditions*

In the previous studies, wide variations in vitamin A potency of milks were noted among individual cows of the same breed. To partially compensate for such individual variations within the breed, ten cows from each breed were chosen as experimental subjects in this phase of the investigation. These cows were selected and handled in a manner similar to those previously described.

Table V portrays a record of the average food consumption and milk production for the five breeds of cows used in these studies.

TABLE V

*The average food consumption and milk production for the five breeds of cows used in this study*

| BREED | GRAIN CONSUMED DAILY | SILAGE CONSUMED DAILY | HAY CONSUMED DAILY | MILK PRODUCED DAILY | FAT PRODUCED DAILY | PER CENT FAT |
|---|---|---|---|---|---|---|
| | *lbs.* | *lbs.* | *lbs.* | *lbs.* | *lbs.* | |
| Holstein | 11.9 | 29.5 | 8.3 | 39.2 | 1.403 | 3.57 |
| Jerseys | 7.1 | 20.8 | 8.3 | 18.6 | 1.146 | 6.15 |
| Guernseys | 7.9 | 22.3 | 8.3 | 22.0 | 1.178 | 5.35 |
| Ayrshires | 10.9 | 27.5 | 8.3 | 32.4 | 1.264 | 3.90 |
| Brown Swiss | 10.3 | 28.6 | 8.3 | 30.0 | 1.154 | 3.84 |

Pooled samples of milk from each of the breeds were taken daily for the purpose of biological assay. These pooled samples consisted of equal volumes of milk from each cow of the group during each of the milking periods. Measured aliquots of the pooled samples of milk from each of the breeds were fed to the experimental animals on the same day they were taken.

The results of the experiment relating to the vitamin A potency of milks produced by representative cows from five major dairy breeds (Table VI) indicate that there is an appreciable difference in vitamin A activity of the milk produced by Holstein, Brown Swiss, Ayrshire, Guernsey, and Jersey cows when maintained under identical nutritive conditions. These results are not in agreement with those of Davis and Hathaway (3) who concluded that there was no difference in vitamin A content of milk produced by different breeds under identical nutritive conditions.

Data obtained in this experiment indicate that there was no appreciable difference in the vitamin A activity of milk fat produced by the different breeds. These results are in agreement with those reported by Wilbur, Hilton, and Hauge (5) who concluded that there was no difference in vitamin A content of milk fat produced by Guernsey and Ayrshire cows.

## CONCLUSIONS

(1) A study of the vitamin A potency of milk from Guernsey and Holstein cows receiving a normal dairy ration showed that individual variations occur within the breed, as well as between the breeds. In general, milks produced by Guernsey cows were higher in vitamin A than milks produced by Holstein cows.

(2) The vitamin A content of milks from Guernsey and Holstein cows which received a pigment-poor ration decreased approximately 70 per cent in seven months. The two breeds of cows responded quite uniformly in this regard under these adverse feeding conditions.

(3) When the cows, depleted of their vitamin A reserves, were subjected to high carotene feeding for a period of twelve days, the administration of 150,000 A.D.M.A. units per day was found to be insufficient to cause an increase in the vitamin A potency of the milks produced by the cows of either breed.

(4) Milks from groups of cows representing five major dairy breeds which were fed the same ration varied in vitamin A activity per unit volume. The vitamin A potency per gram of milk fat, however, was approximately the same for all breeds.

(5) It is concluded that the vitamin A potency of milks from the various dairy breeds is proportional to the percentage of milk fat characteristic of the breed.

TABLE VI

*The vitamin A potency of milks produced by representative cows from five major dairy breeds*

| BREED | NUMBER OF RATS | DOSE CC. | WEIGHT OF RATS AT END OF FORE PERIOD GMS. | WEIGHT OF RATS AT END OF EXPERIMENT GMS. | GAIN IN WEIGHT GMS. | DAILY GAIN PER GRAM OF MILK FED | VITAMIN A UNITS PER QUART | VITAMIN A UNITS PER GRAM OF FAT (SHERMAN) |
|---|---|---|---|---|---|---|---|---|
| Holstein | 7 | 0.6 | 97.1 | 109.0 | 11.9 | 0.70 | 1699 | 20 |
| Holstein | 16 | 1.0 | 108.0 | 135.4 | 27.4 | | | |
| Brown Swiss | 10 | 0.6 | 112.0 | 136.2 | 24.2 | 1.00 | 1980 | 25 |
| Brown Swiss | 17 | 1.0 | 108.0 | 139.9 | 31.9 | | | |
| Ayrshire | 11 | 0.6 | 113.2 | 137.2 | 24.0 | 1.04 | 2157 | 26 |
| Ayrshire | 15 | 1.0 | 114.4 | 149.1 | 34.7 | | | |
| Guernsey | 10 | 0.6 | 102.6 | 128.4 | 25.8 | 1.23 | 2708 | 22 |
| Guernsey | 13 | 1.0 | 107.6 | 151.2 | 43.6 | | | |
| Jersey | 14 | 0.6 | 112.4 | 139.0 | 26.6 | 1.39 | 3212 | 22 |
| Jersey | 14 | 1.0 | 99.5 | 151.2 | 51.7 | | | |

## REFERENCES

(1) MORTON, R. A., AND HEILBRON, I. M. Vitamin A of butter. Biochem. J. 24: 870–873. 1930.

(2) MOORE, T. Vitamin A and Carotin Notes on the conversion of carotin to vitamin A in the cow. Biochem. J. 26: 1–9. 1932.

(3) DAVIS, H. P., AND HATHAWAY, I. L. The vitamin A content of milk of Holstein, Ayrshire, Jersey and Guernsey cows. Nebraska Agric. Exp. Sta. Bulletin No. 54. February, 1931.

(4) HATHAWAY, I. L., AND DAVIS, H. P. The vitamin A content of skimmilk, standardized milk and cream from different breeds of cows. Nebr. Agric. Exp. Sta. Bulletin No. 69. 1933.

(5) WILBUR, J. W., HILTON, J. H., AND HAUGE, S. M. The vitamin A activity of butter produced by Guernsey and Ayrshire cows. JOUR. DAIRY SCI. 16: 153–156. 1933.

(6) SUTTON, T. S., AND KRAUSS, W. E. The vitamin A content of butterfat from Ayrshire, Guernsey, Holstein and Jersey cows. Abstracts of papers presented at the 29th annual meeting of the American Dairy Science Assoc., p. 10. June, 1934.

(7) BOOTH, R. G., KON, S. K., AND GILLAM, A. E. CCLXXXV. The relative biological efficiencies of vitamin A. Biochem. J. 28: 2169. 1934.

(8) BAUMANN, C. A., STEENBOCK, H., BEESON, W. M., AND RUPEL, I. W. Fat-soluble vitamins. XXXIX. The influence of breed and diet of cows on the carotene and vitamin A content of butter. Biochem. J. 105: 167–176. 1934.

(9) GILLAM, A. E., HEILBRON, I. M., MORTON, R. L., BISHOP, C., AND DRUMMOND, C. J. Variations in the quality of butter, particularly in relation to the vitamin A carotene and xanthophyll content as influenced by feeding artificially dried grass to stall fed cattle. Biochem. J. 27: 878. 1933.

(10) FRAPS, G. S., COPELAND, O. C., AND TREICHLER, RAY. The vitamin A requirements of dairy cows. Texas Agri. Exp. Sta. Bul. 495. 1934.

(11) LOY, W. C., HILTON, J. H., WILBUR, J. W., AND HAUGE, S. M. The rate of change in the vitamin A content of milk. JOUR. DAIRY SCI. 20: 31. January, 1937.

# MANAGEMENT AND BREEDING DATA ON A DAIRY HERD IN WHICH BANG'S DISEASE (INFECTIOUS ABORTION) WAS ERADICATED BY SEGREGATION

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## INTRODUCTION

Bang's disease (infectious abortion) was very seriously interfering with progress in the breeding and nutritional investigations being carried on with the dairy herd at Beltsville, Md., by the Bureau of Dairy Industry, United States Department of Agriculture, during the years 1921 to 1926. In that period there were 336 normal calvings and 95 abortions in the herd. Between January 1 and May 10, 1926, the disease became much more serious. In this period there were 21 normal calvings and 16 abortions. It was then decided to attempt to eradicate or control the disease by segregating the infected animals.

## PROCEDURE

The herd was divided into two groups on May 10, 1926, according to the results of the agglutination test for the abortion disease. The abortion-positive animals were moved to new buildings one-half mile from the home buildings where the abortion-negative cows were held.

The home barns and yards were thoroughly cleaned and disinfected, all litter, ropes, implements, cattle, and other movable objects being removed from the stables to facilitate the work. The floors, walls, windows, doors, stanchions and mangers were soaked with water to loosen the dirt and hot water and soap were used in scrubbing the stables. This was followed by a thorough rinsing, then a disinfectant was applied with a force pump. Before the abortion-negative cows were placed in clean stables their bodies, legs, and feet were cleaned of straw, manure, and dirt. The surface of the cowyards was scraped and the scrapings were hauled away. All implements that could not be sterilized with steam were moved to the new buildings for use with the abortion-positive group and new ones were obtained for use in the abortion-negative group.

One crew of attendants cared for the abortion-negative group and another crew cared for the abortion-positive group. The people in charge of experiments, and others who of necessity had to visit the abortion-positive group, had a change of clothing and shoes which they used in order to avoid carrying the abortion infection to the home buildings.

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The milk from the abortion-positive group was brought to the main building and handled in the same processing room as the milk from the abortion-negative group. The milk from the abortion-positive group was not fed to any animals on the farm except as stated in the following paragraph. Manure from the abortion-positive group was taken to cultivated fields only.

At first, the calves born in the abortion-positive group were brought to the home farm as soon as convenient. They were kept in one end of the calf barn until they were 3 months old, when they were placed with other calves in the negative group. Apparently, however, abortion infection was being carried to the negative group by this method of handling the calves. Thereafter the following plan of handling calves was adopted, and was carried out successfully. Calves born in the abortion-positive group were placed in a calf shed on the abortion-positive farm. They were fed milk from the abortion-positive cows until they were 50 to 60 days old. Then they were fed milk from the abortion-negative cows for 10 days, after which they were cleaned free of straw, manure, and dirt, and brought to the home buildings where they were kept separate for 10 days, and then added to the calf herd in the abortion-negative group. There was no evidence of abortion disease being spread by this method of handling calves.

The bulls were kept at the home building. When a bull was to be mated with an abortion-positive cow, he was taken to neutral ground near the abortion-positive quarters. As soon as the mating materialized, the bull was led away and no animals were allowed to approach the place of breeding until another mating. Cows in both groups were mated with the same bulls but the abortion-negative cows were bred at the home buildings. Only animals with apparently healthy genital organs were mated, therefore the bulls were not treated or disinfected in any way before or following matings. No evidence of spreading abortion disease by this manner of mating could be established.

### *Animals Segregated*

When the initial separation was completed the abortion-negative group consisted of 65 females of breeding age and the abortion-positive group contained 82 females of breeding age. The number of animals added to the abortion-positive group from time to time is shown in Table 1.

Some of the animals in the negative group that reacted during 1926 (See Table 1, Column 1) may have been infected before the herd was divided. Eight cows may have become infected by coming in contact with manure from calves brought from the abortion-positive group. These cows had followed the manure spreader in a pasture and nosed the manure that fell to the ground. All of them reacted to the agglutination test a month later. This observation caused the change in the plan of handling the calves born in the abortion-positive group, as mentioned before. Carelessness in the

TABLE 1

*Intervals at which the agglutination test was applied to the abortion-negative group, and the number of cows that became positive and that were added to the positive group each year (from May 11, 1926, to October 4, 1935)*

| | 5-11-26 TO 5-10-27 | 5-11-27 TO 5-10-28 | 5-11-28 TO 5-10-29 | 5-11-29 TO 5-10-30 | 5-11-30 TO 5-10-31 | 5-11-31 TO 5-10-32 | 5-11-32 TO 5-10-33 | 5-11-33 TO 5-10-34 | 5-11-34 TO 5-11-35 | 5-11-35 TO 10-4-35 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Interval at which the negative group was tested.* (days) | 60 | 60 | 180 | 60 | 60 | 60 | 30 | 30 | 30 | 60 | |
| Cows becoming positive that were added to the positive group.** (number) | 24 | 0 | 14 | 3 | 8 | 28 | 2 | 1** | 0 | 0 | 80 |

* All of the serological and bacteriological work in connection with abortion disease in the herd was done by the Bureau of Animal Industry at its animal disease station.

** This animal was born of an abortion-positive dam and continued to be positive until past breeding age.

testing of milk from the abortion-positive cows in one of the abortion-negative barns may have been responsible for the outbreak in 1928–29. An actual abortion in the negative group kept the infection active for some time. The large number of animals becoming positive in 1931 (See Table 1, Columns 5 and 6) was due probably to the infection being carried by people coming in contact with both groups. Due to the fact that the construction of buildings made it necessary for cows to calve in communicating stalls and small yards near the barns at this particular time, the infection was kept active. The outbreak stopped when more strict supervision over communication between the two groups was put in force and when the cows calved in the maternity barn again, and were held there until they passed a negative blood test. No cows or calves have become positive since June, 1932. One calf that was born previous to that time, however, has continued positive to maturity.

### DISPOSAL OF ANIMALS

The experiments to which the cows were assigned before the herd was divided were continued in each group. Some of the cows died and others were disposed of when they no longer were needed in the experiments. Forty-seven females were added to the abortion-negative group, in addition to the female offspring of both groups and by January 1, 1936, the negative group had increased to 262 abortion-negative females of breeding age. Part of these 262 females of breeding age are the offspring of the progeny of the original groups of cows. The abortion-positive group gradually became smaller with the disposal of the animals as they became unfit for further use or were no longer needed for experimental work. The last of these animals was disposed of October 4, 1935. Table 2 shows the number of animals disposed of each year while the two groups were maintained.

### FERTILITY

In this report the term fertile is used to designate females that conceived, regardless of whether or not they produced normal live calves. The breeding efficiency of cows is determined by finding the percentage of the females actually bred that conceived.

The 65 animals remaining in the initial abortion-negative group were bred for 213 pregnancies and 191 conceptions occurred, representing an average breeding efficiency of 89.67 per cent. The 82 abortion-positive cows that were moved to new quarters when the initial separation was made, were bred for 296 pregnancies and 269 conceptions occurred, representing an average breeding efficiency of 90.87 per cent. The 80 animals subsequently added to the abortion-positive group were bred for 261 pregnancies and 229 conceptions occurred, representing an average breeding efficiency of 87.73 per cent. The total number of 162 abortion-positive animals were bred for 557 pregnancies and 498 conceptions occurred, representing an average

TABLE 2

*Number of females disposed of from the various groups each year from May 11, 1926, to October 4, 1935*

| GROUP, AND NUMBER OF FEMALES | 5-11-26 TO 5-10-27 | 5-11-27 TO 5-10-28 | 5-11-28 TO 5-10-29 | 5-11-29 TO 5-10-30 | 5-11-30 TO 5-10-31 | 5-11-31 TO 5-10-32 | 5-11-32 TO 5-10-33 | 5-11-33 TO 5-10-34 | 5-11-34 TO 5-10-35 | 5-11-35 TO 10-4-35 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial negative group (65 cows) | 22 | 5 | 6 | 1 | 8 | 5 | 6 | 3 | 8 | 1 | 65 |
| Initial positive group (82 cows) | 17 | 9 | 9 | 9 | 11 | 10 | 6 | 3 | 6 | 2 | 82 |
| Transfers from negative to positive group (80 cows) | 3 | 2 | 4 | 2 | 8 | 10 | 12 | 11 | 18 | 10 | 80 |
| Total positive females (162) | 20 | 11 | 13 | 11 | 19 | 20 | 18 | 14 | 24 | 12 | 162 |
| Total disposal, all groups | 42 | 16 | 19 | 12 | 27 | 25 | 24 | 17 | 32 | 13 | 227 |

breeding efficiency of 89.40 per cent, while in the positive group the 80 cows that were transferred from the negative to the positive group had a lower average breeding efficiency than either of the initial groups, but the average for all positive animals was about the same as that for all the negative animals. Apparently the abortion disease in this herd did not lessen the fertility of the infected animals.

### SERVICES REQUIRED FOR CONCEPTION

Table 3 shows that the average number of matings required for a conception in the two initial groups was similar. The initial abortion-negative group contained 14 heifers that averaged 4.14 matings for a first conception as compared with 2.82 for cows in the same group. In the initial abortion-positive group 11 heifers averaged 4.54 matings for a first conception as compared with 2.51 for cows in the same group. The larger number of services required for heifers than for cows raised the average number of matings for a conception in both initial groups. The 80 animals subsequently added to the abortion-positive group required a higher average number of matings for a conception than either of the initial groups.

### DISTRIBUTION OF SERVICES

Approximately 31 per cent of the conceptions among the cows that were added to the abortion-positive group resulted from the first mating as compared to 36 and 40 per cent in the two initial groups. (See Table 4.) This table shows for the four groups of cows (the fourth group being the second and third groups combined) the number of animals bred 1 to 10 or more times for each conception. In the first group, 213 cows were bred and 77, or 36.15 per cent, conceived at the first mating. This left 136 to be bred two or more times. On the second service 39, or 28.67 per cent of the 136 animals conceived leaving 97 to be bred three or more times. On the third mating in this group one cow was removed because she was thought to be permanently sterile and 19 conceived. All cows were examined before breeding and those requiring four or more services were examined again for abnormalities of the genital organs. Of the fertile cows in the initial abortion-negative group 81 per cent conceived on the first to the fourth mating and the others were bred five or more times for a conception. In the initial abortion-positive group 81 per cent conceived on the first to the fourth mating, and in the group of animals added to the initial abortion-positive group 76.95 per cent conceived on the first to the fourth mating. The largest number of animals discarded because of permanent sterility came from the group that was added to the initial abortion-positive group, the number being 31, or 38.75 per cent, while in the two initial groups the numbers were 21, or 32.21 per cent, and 25, or 30.43 per cent. It should be added, however, that in the initial abortion-positive group some animals

TABLE 3

*Average number of services required for a conception by fertile females in the different groups, and the results of pregnancies (from May 11, 1926, to October 4, 1935)*

| GROUP, AND NUMBER OF FEMALES | TOTAL CONCEPTIONS | | | RESULTS OF PREGNANCIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Live calves | | | Calves born dead | | | Abortions | | |
| | Number | Services | | Number | Services | | Number | Services | | Number | Services | |
| | | Total | Average | | Total | Average | | Total | Average | | Total | Average |
| Initial negative group (51 cows and 14 heifers) | 191 | 558 | 2.92 | 157 | 456 | 2.90 | 16 | 53 | 3.31 | 15 | 43 | 2.86 |
| Initial positive group (71 cows and 11 heifers) | 269 | 798 | 2.96 | 196 | 556 | 2.83 | 19 | 62 | 3.26 | 41 | 117 | 2.85 |
| Transfers from negative to positive group (80 cows) | 229 | 754 | 3.29 | 134 | 428 | 3.19 | 18 | 75 | 4.16 | 71 | 241 | 3.39 |
| Total positive females (162) | 498 | 1,552 | 3.11 | 330 | 984 | 2.98 | 37 | 137 | 3.54 | 112 | 358 | 3.19 |

TABLE 4

*Number and percentage of females in each group that conceived after being bred from 1 to 30 times, and the number and percentage that were discarded as sterile (1926–1935)*

| NUMBER OF TIMES BRED | FEMALES IN INITIAL NEGATIVE GROUP | | | | | FEMALES IN INITIAL POSITIVE GROUP | | | | | FEMALES TRANSFERRED FROM NEGATIVE TO POSITIVE GROUP | | | | | TOTAL POSITIVE FEMALES | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bred | Conceiving | | Discarded as sterile | | Bred | Conceiving | | Discarded as sterile | | Bred | Conceiving | | Discarded as sterile | | Bred | Conceiving | | Discarded as sterile | |
| | *number* | *number* | *per cent* | *number* | *per cent* | *number* | *number* | *per cent* | *number* | *per cent* | *number* | *number* | *per cent* | *number* | *per cent* | *number* | *number* | *per cent* | *number* | *per cent* |
| None | 0 | 0 | 0.00 | 0 | 0.00 | 0 | 0 | 0.00 | 2 | 0.00 | 0 | 0 | 0.00 | 3 | 0.00 | 0 | 0 | 0.00 | 5 | |
| 1 | 213 | 77 | 36.15 | 0 | 0.00 | 296 | 119 | 40.20 | 1 | 0.33 | 261 | 82 | 31.41 | 1 | 0.38 | 557 | 201 | 36.08 | 2 | 0.35 |
| 2 | 136 | 39 | 28.67 | 0 | 0.00 | 176 | 48 | 27.27 | 0 | 0.00 | 178 | 43 | 24.15 | 1 | 0.56 | 354 | 91 | 25.70 | 1 | 0.28 |
| 3 | 97 | 19 | 19.58 | 1 | 1.03 | 128 | 39 | 30.46 | 2 | 1.56 | 134 | 27 | 20.14 | 1 | 0.74 | 262 | 66 | 25.26 | 3 | 1.14 |
| 4 | 77 | 21 | 27.27 | 3 | 3.89 | 87 | 14 | 16.09 | 3 | 3.44 | 106 | 25 | 23.58 | 2 | 1.88 | 193 | 39 | 20.20 | 5 | 2.59 |
| 5 | 53 | 7 | 13.20 | 0 | 0.00 | 70 | 17 | 24.28 | 2 | 2.85 | 79 | 19 | 24.05 | 2 | 2.53 | 149 | 36 | 24.16 | 4 | 2.68 |
| 6 | 46 | 11 | 23.91 | 4 | 8.69 | 51 | 7 | 13.72 | 0 | 0.00 | 58 | 7 | 12.06 | 1 | 1.72 | 109 | 14 | 12.84 | 1 | 0.91 |
| 7 | 31 | 6 | 19.35 | 1 | 3.22 | 44 | 4 | 9.09 | 4 | 9.09 | 50 | 9 | 18.00 | 3 | 6.00 | 94 | 13 | 13.82 | 7 | 7.44 |
| 8 | 24 | 5 | 20.83 | 0 | 0.00 | 36 | 6 | 16.66 | 2 | 5.55 | 38 | 5 | 13.15 | 1 | 2.36 | 74 | 11 | 14.86 | 3 | 4.05 |
| 9 | 19 | 2 | 10.52 | 1 | 5.26 | 28 | 5 | 17.85 | 0 | 0.00 | 32 | 3 | 9.37 | 3 | 9.37 | 60 | 8 | 13.33 | 3 | 5.00 |
| 10 | 16 | 0 | 0.00 | 1 | 6.25 | 23 | 2 | 8.69 | 1 | 4.34 | 26 | 3 | 11.53 | 1 | 3.84 | 49 | 5 | 10.20 | 2 | 4.89 |
| 11–20 | 15 | 5 | 33.33 | 8 | 53.33 | 20 | 8 | 40.00 | 8 | 40.00 | 22 | 6 | 27.27 | 15 | 68.18 | 42 | 14 | 33.33 | 23 | 54.76 |
| 21–30 | 2 | 0 | 0.00 | 2 | 100.00 | 4 | 2 | 50.00 | 2 | 50.00 | 1 | 1 | 100.00 | 0 | 0.00 | 5 | 3 | 60.00 | 2 | 40.00 |

were discarded early in life, for various reasons, that might have become sterile if kept longer. Diagnosis of permanent sterility was made only when the animals were slaughtered and the genital organs carefully examined.

### NUMBER OF MATINGS FOR CONCEPTION AFTER A NORMAL CALVING AND AFTER AN ABORTION

The data presented in Table 5 indicate that, in the abortion-positive group, more matings were required on an average for a conception after an abortion than after a normal calving. In the abortion-negative group the average number of services for a conception was somewhat less after an abortion than after a normal calving, though the number of cases in the abortion-negative group in which conception followed an abortion is rather small. Since the abortions in the abortion-negative group were not due to *Brucella abortus*, and since most of the abortions in the abortion-positive group were, these results may indicate that abortions caused by *Brucella abortus* are more harmful to the genital organs than either full-term pregnancies or abortions due to other causes.

TABLE 5

*Average number of services required for conception after a normal calving and after an abortion (from May 11, 1926, to October 4, 1935)*

| GROUP | BRED AFTER A NORMAL CALVING | | | BRED AFTER AN ABORTION | | |
|---|---|---|---|---|---|---|
| | Total conceptions | Services | | Total conceptions | Services | |
| | | Total | Average | | Total | Average |
| Initial negative group | 131 | 388 | 2.96 | 12 | 28 | 2.33 |
| Initial positive group | 173 | 428 | 2.47 | 30 | 98 | 3.26 |
| Transfers from negative to positive group | 101 | 295 | 2.92 | 53 | 168 | 3.16 |
| Total positive females | 274 | 723 | 2.63 | 83 | 266 | 3.20 |

The results of pregnancies were classed as live calves, calves born dead, abortions, and fetuses found on autopsies. When a calf was born alive, normally developed, able to stand and nurse its dam, it was designated as a living calf. All calves delivered which apparently were lacking in intrauterine development were termed abortions. This includes so-called premature calves that lived only a few hours after birth. All mummified fetuses were classified as calves born dead. Other calves were born dead after a gestation of normal length. The majority of these died during delivery. There is no great difference in the number of calves born dead in the different groups. The percentage of abortions among the animals that became

reactors after the original segregation is a little more than double that in the original group of abortion-positive cows. (See Table 6.) The cows that were added to the abortion-positive group from time to time also required a higher average number of matings for a conception than the original abortion-positive cows. (See Table 3.) Abortion due to *Brucella abortus* was at its peak of destruction in the herd about the time the herd was divided, as is shown by the number of abortions recorded in the introduction of this report. Many of the abortions just before the division of the herd were from young animals. At the time of testing and dividing the herd 28 of the older cows reacted to the agglutination test in dilutions of 1 part of serum to 50 parts of bacterial suspension or less, and 20 of the younger animals reacted in dilutions of 1 part of serum to 500 parts of the bacterial suspension or more, and the others reacted in dilutions of 1 part of serum to 100 parts of bacterial suspension or more. The animals that were added to the initial abortion-positive group from time to time apparently carried a newly acquired infection which reached its peak of virulency shortly after they were added to the reacting herd. Six of these animals reacted to the agglutination test in a dilution of 1 part of serum to 100 parts of bacterial suspension and all the others reacted in dilutions of 1 part of serum to 200 parts of bacterial suspension or more. The results indicate that the disease was more severe in newly infected animals, which accounts for the fact that the cows that were added to the abortion-positive group had more abortions and required more services for a conception than the cows in the initial positive group. Table 6 shows that the percentage of live calves was largest in the abortion-negative group and smallest among the animals that were added to the abortion-positive group from time to time.

Experiments were occasionally conducted in both the abortion-negative and abortion-positive groups that required the animals to be held open 5 to 8 months after freshening. This practice has some effect on the results of pregnancies, as shown in Table 7. Although the data in Table 7 cover the period during which the reactors and nonreactors were maintained in separate groups, they do not cover the entire life of many of the individual animals, since some of them were mature and some were old when the segregation was made. The same is true of the animals added to the abortion-positive group from time to time. For these reasons the average number of years the cows were in the herd, as shown in Table 7, Column 3, is low, though the average is about even in the different groups. Table 7 shows that the average number of pregnancies each cow-year was greater among the abortion-positive cows. This apparently was due to the shortened gestation periods brought on by the larger number of abortions among the abortion-positive animals. A truer value of the usefulness of the cows as breeding animals is indicated by the average number of live calves born in a cow-year. (See Table 7.) These averages indicate the cows added to the abortion-positive group were the least useful as breeding animals.

TABLE 6

*Results of pregnancies in the different groups (from May 11, 1926, to October 4, 1935)*

| GROUP AND NUMBER OF FEMALES | TOTAL PREGNANCIES | LIVE CALVES | | DEAD CALVES | | ABORTIONS | | FETUSES FOUND ON AUTOPSY | |
|---|---|---|---|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| Initial negative group (65 cows) | 191 | 157 | 82.19 | 16 | 8.37 | 15 | 7.84 | 3 | 1.51 |
| Initial positive group (82 cows) | 260 | 196 | 72.86 | 19 | 7.06 | 41 | 15.24 | 13 | 4.83 |
| Transfer from negative to positive group (80 cows) | 229 | 134 | 58.42 | 18 | 7.92 | 71 | 31.00 | 6 | 2.62 |
| Total positive females (162 cows) | 498 | 330 | 66.26 | 37 | 7.42 | 112 | 22.48 | 19 | 3.81 |

TABLE 7

*Data on cow-years and pregnancies in each group (1926–1935) (Cow-year is 12 months in this table)*

| GROUP AND NUMBER OF FEMALES | COW-YEARS | AVERAGE NUMBER YEARS COWS IN HERD | TOTAL PREG-NANCIES | AVERAGE NUMBER PREG-NANCIES EACH COW | AVERAGE NUMBER PREG-NANCIES EACH COW-YEAR | NUMBER OF LIVE CALVES | AVERAGE NUMBER OF LIVE CALVES EACH COW-YEAR |
|---|---|---|---|---|---|---|---|
| Initial negative group (65 cows) | 229.53 | 3.53 | 191 | 2.92 | 0.83 | 157 | 0.68 |
| Initial positive group (82 cows) | 308.75 | 3.76 | 269 | 3.28 | 0.87 | 196 | 0.63 |
| Transfer from negative to positive group (80 cows) | 263.55 | 3.29 | 229 | 2.86 | 0.86 | 134 | 0.50 |
| Total positive females (162 cows) | 572.36 | 3.53 | 498 | 3.07 | 0.87 | 330 | 0.57 |

## SEX RATIO

The data in Table 8 present the number and sex of calves and fetuses during the 9 years 5 months the two groups were segregated. Both members of all twins of the same sex were tabulated and both members of mixed twins were omitted. Some fetuses were mutilated and the sex of others was not definitely observed, which accounts for those listed as of unknown sex. There were 21 sets of twins, 10 of them mixed twins, among the 689 pregnancies accounted for. The known sexes of aborted fetuses were 33 females and 47 males.

TABLE 8

*Sex of calves and fetuses during 9 year 5 month period (May 10, 1926, to October 4, 1935)*

| GROUP AND NUMBER OF FEMALES | NUMBER OF FEMALE CALVES | NUMBER OF MALE CALVES | NUMBER OF SETS OF MIXED TWINS | NUMBER OF CALVES SEX UNKNOWN |
|---|---|---|---|---|
| Initial negative group (65 cows) | 94 | 90 | 5 | 7 |
| Initial positive group (82 cows) | 106 | 138 | 3 | 23 |
| Transfer from negative to positive group (80 cows) | 100 | 106 | 2 | 24 |
| Total positive females (162 cows) | 206 | 244 | 5 | 47 |

## SUMMARY

Initial division of the herd was made on May 10, 1926, according to the results of the agglutination test for Bang's disease (infectious abortion).

The abortion-negative group consisted of 65 females of breeding age and the abortion-positive group 82 females of breeding age. The 82 reactors were moved to new buildings, about one-half mile from the home buildings, where the 65 nonreactors were held. From May 21, 1926, to June 18, 1932, 80 cows from the abortion-negative group were added to the abortion-positive group. The abortion-positive group was terminated October 4, 1935.

Mere division of the herd was not effective in preventing the spread of the disease. Strict supervision of all communication between the two groups stopped the spread of the disease. Different crews cared for the different groups of animals. The milk from the two groups was handled in the same room at the home buildings.

Calves born in the abortion-positive group were fed milk from that group until they were 50 to 60 days old, then changed to milk from the abortion-negative group for 10 days, after which they were taken to the home buildings and isolated for 10 days before being placed with the other calves in the abortion-negative group.

The same bulls were bred to abortion-negative and abortion-positive cows without evidence of their spreading the disease.

The group of 80 cows added to the abortion-positive group from time to time required more services for a conception than any other group, and the percentage of conceptions resulting from the first four services was smaller in this group than in any other. The percentage of pregnancies terminating in live calves was also smaller in this group than in any other group. This group was also less efficient than the other groups, as judged by the average number of live calves per cow-year. The less favorable showing of these 80 cows was probably due to the fact that they became positive and went through the most serious phase of the disease during the period covered by these data, while many of the animals in the original positive group had already passed through the most serious phases of the disease prior to segregation and were not so seriously affected during the period covered by these data.

The abortion-positive cows required more services for a conception when bred after an abortion than when bred after a normal calving.

The sex of calves and fetuses is given for the time the abortion-positive group was maintained.

# THE ELECTROKINETIC POTENTIAL OF MILK FAT[1]

## I. GENERAL ELECTROPHORETIC STUDIES

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### INTRODUCTION

It has been known for many years that milk fat globules are electrically charged. The explanations offered to account for some dairy phenomena have been based wholly, or in part, upon this fact, but few quantitative data have been presented to substantiate the theory. This study was undertaken to secure information regarding the magnitude of the potential under normal conditions and the effect of various agents upon it; the correlation between changes in the magnitude of the potential and certain known behaviors of fat globules under conditions of usual commercial dairy practice; and the nature of the interface between the fat globule and the surrounding medium as revealed by studying alterations in the potential.

### HISTORICAL

Abramson (1) has compiled an excellent summary of the theoretical and practical development of the general field of electrokinetics. In specific relation to milk fat Jürgenson (2) in 1860 was probably the first to note the migration of milk fat globules in an electrical field. He observed that the globules moved toward the positive pole and concluded that they were negatively charged. Sirks (3) found that the potential at the fat globule milk plasma interface was of a low order of magnitude and he was unable to correlate it with any dairy phenomena.

Mommsen (4) found the isoelectric point of fat globules in cream to be pH 4.17. Additions of gelatin caused a shift to the isoelectric point of gelatin. Prieger (5) reported that the isoelectric point of milk fat emulsified in distilled water was on the acid side of that found in a milk emulsion.

Mohr and Brockmann (6) report the isoelectric point of milk fat globules to be pH 4.3 in an acetate buffer. At this pH the exhaustiveness of churning of cream was found to be most pronounced. Heating and homogenization, they claim, had no effect on the position of the isoelectric point. They found that there was no apparent relation between the mobility of the fat globules and surface tension or viscosity but that the addition of casein brought the isoelectric point to pH 4.44.

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* The data presented in this paper are from a thesis submitted to the Graduate School of the Penna. State College in partial fulfillment of the degree of Doctor of Philosophy, 1936.

North and Sommer (7) have presented a method of streaming potential measurements adapted to milk fat. They found that the magnitude of the measurements was a function of the temperature. The potential was found to be negative and the isoelectric point in the region of pH 4.3. Added salts affected the potential: phosphate and citrate ions increased the potential while calcium, ferric, and thorium ions decreased it. These authors report a variation in potential as great as fifty per cent when skim milk from different individual cows is streamed through a milk fat capillary.

## EXPERIMENTAL PROCEDURE

There are three methods available for measuring electrokinetic potentials: electrophoresis, the streaming potential method, and electroendosmose. These have been compared by Bull (8) who found them to give practically identical values. After a critical consideration of the system to be studied and an analysis of the factors affecting changes in this system, the method of electrophoresis was chosen.

The mathematical expression relating electrophoretic mobility of a charged particle to its zeta potential has been developed by Schmoluchowski (9). It shows that

$$\zeta = \frac{4\pi\eta v}{E\varepsilon}$$

where $\zeta$ is zeta potential, v is the velocity of migration of the particle, $\eta$ is the absolute viscosity, E is the voltage applied per unit distance between electrodes, $\varepsilon$ is the dielectric constant. Recently, Debye and Hückel (10) have contended that the factor *four* should be *six* for particles of a particular size and shape.

The electrophoretic apparatus used in this work was the Mudd Modification of the Northrup-Kunitz cell (11). This has been described in detail by Moyer (12). An E.M.F. of 135 volts from three radio "B" batteries was used. The microscopic equipment consists of a microscope equipped with a 21 × objective having a working distance of 1.8 mm. and a 25 × ocular. The light source was from a micro-lamp and the light was filtered through a copper sulphate solution. The distance traversed by the migrating particles was measured on a calibrated ocular micrometer and the elapsed time noted by means of a stop-watch.

A measurement consisted of noting the time necessary for a globule to pass a standard number of micrometer spaces. Measurements were made at 0.21 and 0.79 of the depth of the cell at which points it has been shown that actual electrophoretic velocities are obtained. Because of the opaque character of the milk, dilution was necessary. The standard procedure of diluting with 200 parts of distilled water was adopted after preliminary trials had shown that dilution in the range of 1:100 up to 1:800 was without effect on the mobility. Five measurements were made at 0.21 depth

with the current flowing in one direction, the current was then reversed and five measurements were made in the opposite direction after which the microscope was focused at the 0.79 depth and ten more measurements were made as noted above. The average of these twenty readings was used to calculate the mobility in terms of micra per second per volt per centimeter, considering the distance traversed, the E.M.F. applied, and the potential drop across the cell.

The cell was previously standardized according to directions supplied by the manufacturer.

## EXPERIMENTAL DATA

### *The Effect of Temperature*

The fundamental equation given above relating electrophoretic mobility to zeta potential indicates that the magnitude of the potential is not affected by changes in temperature. To determine the effect of temperature upon the mobility, measurements of mobility were made over a temperature range from 15° C. to 30° C.

TABLE 1

*The effect of temperature on electrophoretic mobility*

| TEMPERATURE | MOBILITY |
|---|---|
| °C. | μ/sec./v/cm. |
| 15.0 | 1.98 |
| 20.0 | 2.30 |
| 22.5 | 2.42 |
| 25.0 | 2.56 |
| 28.8 | 2.76 |
| 30.0 | 2.83 |

The percentage change in mobility, as shown in Table 1, is two per cent per degree at 25° C. and corresponds to the viscosity change in water in this temperature range. Moyer (12) also has shown that this relationship is true. With this fact in mind all values were corrected to 25° C.

TABLE 2

*Electrophoretic mobility according to breed of cows*

| BREED | APPROX. DIAMETER OF GLOBULES | MOBILITIES |
|---|---|---|
| | Micra | μ/sec./v/cm. |
| Holstein-Friesian | 3.0 | 2.56 |
| Ayrshire | 3.5 | 2.53 |
| Guernsey | 5.0 | 2.53 |
| Jersey | 6.0 | 2.51 |
| Brown Swiss | 4.0 | 2.55 |

### *The Effect of Breed of Cows*

Electrophoretic mobilities of fat globules from cows of each of the five major dairy breeds were determined by the method previously outlined. The differences, reported in Table 2, were not considered significant.

### *The Isoelectric Point of Milk Fat*

Measurements of mobilities were made at different pH values in an acetate buffer and in a citrate buffer. The curves obtained are shown in Figure 1.

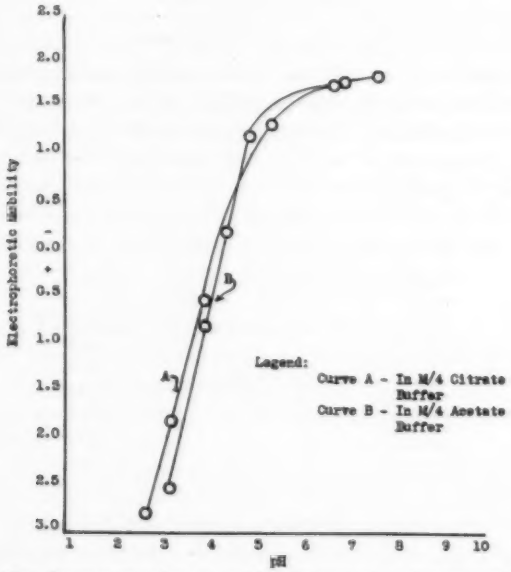


FIG. 1. THE ISOELECTRIC POINT OF FAT GLOBULES IN DIFFERENT BUFFERS

Each curve has a different slope but both show the same point of zero mobility of fat globules at pH 4.3. This is in agreement with the results obtained by Mohr and Brockmann and by North and Sommer cited previously.

### *The Effect of Added Salts*

Salts yielding ions of different valences were used to note the effect upon the mobility of the fat globules. In one series potassium, calcium, ferric and thorium ions were added as chloride salts in equal chloride ion concentration; in the other series, the sodium salts of secondary phosphate and citrate were added in equal sodium ion concentration. The effect upon the mobility of the fat globules is shown in Figure 2.

The trend of these data is similar to the results reported by North and Sommer (7) using a streaming potential method.

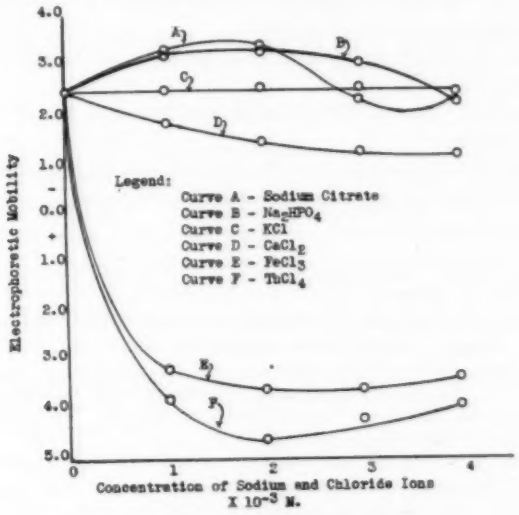


FIG. 2. THE EFFECT OF ADDED SALTS

## DISCUSSION OF RESULTS

It is impossible to say what effect the dilution of milk by 100 parts of water has upon the mobility of the fat globules. The fact that further dilution has no effect suggests the possibility that the potential of the fat globule results from ionization of adsorbed materials rather than from adsorption of ions since dilution would decrease the concentration of ions and alter the mobility.

The significance of the isoelectric point lies in the fact that it indicates something as to the nature of the substances present at the surface of the globules. The isoelectric point of casein is given as pH 4.6 (13) and that of whey proteins is given by Okuda and Zoller (14) as pH 4.5. Data to be presented later show that milk phospholipids have their isoelectric point at pH 2.0. This evidence indicates that the surface layer of the fat globules is essentially protein but that some other material with a lower isoelectric point, undoubtedly a phospholipid, is also present.

## SUMMARY AND CONCLUSIONS

An electrophoretic method for studying the electrokinetic potential of milk fat is described. Results are expressed as electrophoretic mobilities considered proportional to the electrokinetic potential.

Dilution of milk within the range of 1 : 100 to 1 : 800 had no effect on the mobility.

Changes in temperature resulted in like changes in mobility equal to two per cent per degree centigrade at 25°.

There was no significant difference in mobility of fat globules from cows of different breeds.

The isoelectric point of fat globules was found to be pH 4.3 in acetate and citrate buffers.

Additions of salts resulted in changes in mobility in accordance with the valence and sign of the ions furnished by the salts.

## REFERENCES

(1) ABRAMSON, H. A. Electrokinetic phenomena. The Chemical Catalog Co., Inc., New York, N. Y. 1934.

(2) JÜRGENSEN, v. THEO. AUS F. Über die Bewegung fester im Flüssigkeiten suspendirtir Körper unter den Einfluss des Electrischen Stroms. Archiv für Anatomie, Physiologie,u.s.w., p. 673. 1860.

(3) SIRKS, H. A. On the agglutination of butterfat globules and their electric charge. Landhourek Undersaek. Rijalandhouwpraep **29**: 137. 1924. (Chem. Abst. **17**: 1568 and **19**: 301, original not seen.)

(4) MOMMSEN, H. Über die Kataphorese von Kuhmilch und Frauenmilch. Monatschrift für Kinder Heilkunde **42**: 361. 1932.

(5) PRIEGER, I. Über die Hüllen der Milchfettkügelchen. Bio. Chem. Zeit. **217**: 331. 1930.

(6) MOHR, W., AND BROCKMANN, C. Kataphorese von Kuhmilch. Milchwirtsch. Forsch. **11**: 216. 1930.

(7) NORTH, G. C., AND SOMMER, H. H. Electrokinetics in relation to dairy phenomena. JOUR. DAIRY SCI. **18**: 21. 1935.

(8) BULL, H. B. A critical comparison of electrophoresis, streaming potential, and electroosmosis. Jour. Phys. Chem. **39**: 597. 1935.

(9) SCHMOLUCHOWSKI, v. In Graetz Handb. d. Electriz. **2**: 302. 1914.

(10) DEBYE, P., AND HÜCKEL, E. Bemerkung zu einem Satze über die Kataphoretische Wanderungsgeschwindigkeit suspendirtir Teilchen. Physik. Zeit. **25**: 49. 1924.

(11) MUDD, STUART, *et al.* Methods of studying the surfaces of living cells with especial reference to the relation between surface properties and the phagocytosis of bacteria. Colloid Symposium Mon. **6**: 131. 1928.

(12) MOYER, L. S. Species relationships in *Euphorobia* as shown by electrophoresis of latex. Am. Jour. Bot. **21**: 293. 1934.

(13) PALMER, L. S. Experiments in dairy chemistry. John Wiley and Sons, New York. 1926.

(14) OKUDA AND ZOLLER. The relation of hydrogen ion concentration to the heat coagulation of proteins in Swiss cheese whey. Ind. and Eng. Chem. **13**: 515. 1921.

# OBSERVATIONS ON THE CAROTENE CONTENT OF SOME TYPICAL PASTURE PLANTS[1]

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A PRELIMINARY REPORT

Only in recent years has vitamin A been considered a limiting factor in the well-being of cattle under ordinary feeding conditions. Hart and Guilbert (8) reported evidence of vitamin A deficiency in range cattle after unusually prolonged dry feeding periods. Results such as reproductive failure, and dead, weak or sick calves were more common when the feed was ample, and complete except in vitamin A potency. They concluded (6) that the storage of vitamin A during the green feed season is sufficient to carry range animals safely through the dry-feed periods of ordinary duration. In discussing dairy cattle feeding, Woodward and Nystrom (15) state that vitamin A is the vitamin most likely to be deficient.

Meigs and Converse (11, 12) reported that in the case of liberally milking cows the ration is likely to be deficient in vitamin A if it consists of grain, silage and hay without pasture, unless good quality hay is generously fed. Calves could not be successfully raised on milk produced from rations based on poor quality hay. Converse and Meigs (2) have shown that in raising calves on restricted quantities of whole milk the limiting factor is the vitamin A content of the butter fat rather than any other inherent qualities of the fat.

Ample evidence is available (1, 5, 9, 10, 13) showing that the vitamin A potency of butter is largely dependent on the ration consumed by the cows. Butter with high vitamin A content is important in human nutrition.

Considering the large percentage of dairy cows fed on poor quality roughage, perhaps the pasture feeding period may be the balance wheel in the entire year's feeding program. Without the annual pasturage season, many ill effects might result.

Dutcher (4) states that the vitamin content of leafy plants and vegetables may be correlated with greenness, metabolic activity, and maturity, the old mature tissues tending to be less valuable sources of vitamin A than young rapidly metabolizing tissues. Virtanen (16) reported that the proportions of carotene (the precursor of Vitamin A) in plants are higher the better the plant grows, attaining a maximum before or at the beginning of flowering. He further stated that proper fertilization increases the carotene content, while factors which retard growth lowers the carotene content.

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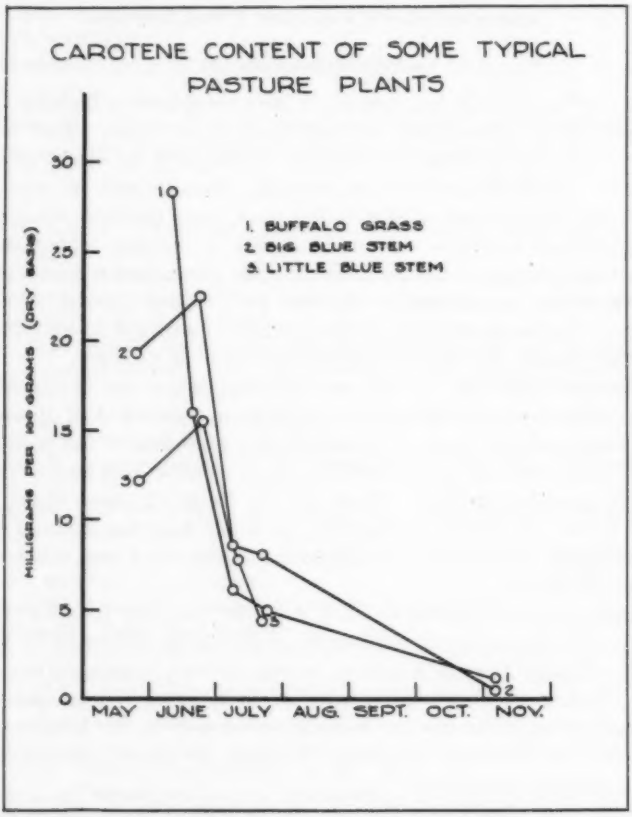
Coward (3) found that vitamin A is completely destroyed when the leaves of plants dry up, become brown, and die.

The importance of pasture as a source of carotene for dairy cows, the variety of plants used for pasture—either alone or in mixtures—and the




differences in the growth habits of pasture plants seemed to justify study of the carotene content of some of the common pasture plants at different periods in the year. The results presented are a preliminary report on such a study.

## EXPERIMENTAL

Thirteen pasture plants, typical of those used for pasture purposes in Kansas, were selected for study. Samples were taken from pure stands maintained in Department of Agronomy plots. Sampling was done by grasping branches of grass in a manner similar to the way in which the cow might graze. The different plants varied in height from 6 to 15 inches at

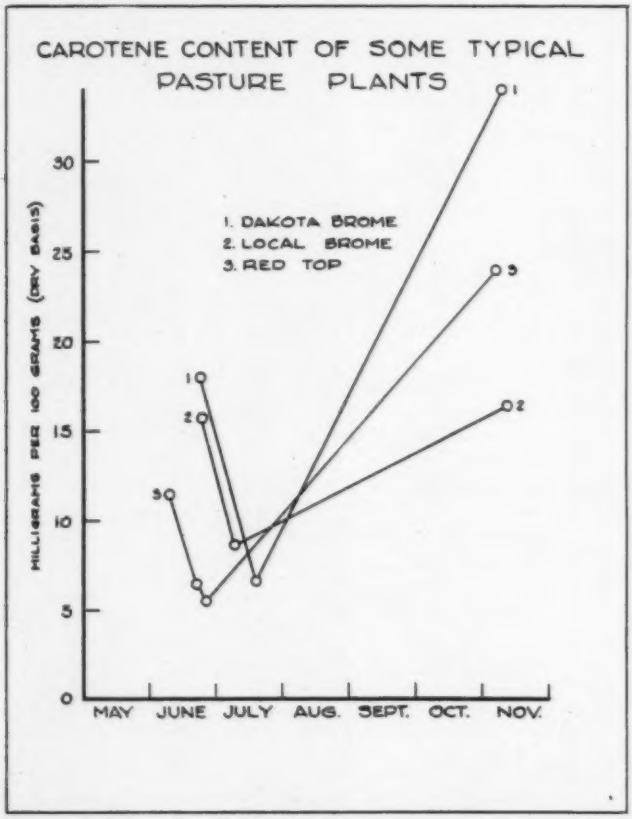
TABLE I

*Carotene content of some pasture plants at different periods throughout the growing season*

| DATE SAMPLE TAKEN | PASTURE PLANTS STUDIED | CAROTENE PER 100 G. | | CAROTENE PER LB. | | MOISTURE |
|---|---|---|---|---|---|---|
| | | Fresh | Dry | Fresh | Dry | |
| | | *mg.* | *mg.* | *mg.* | *mg.* | *per cent* |
| 5–22 | Rye | 5.5 | 25.1 | 25.1 | 114.0 | 82.3 |
| 11–28 | " | 8.4 | 30.6 | 37.9 | 138.8 | 72.7 |
| 5–23 | Big blue stem | 4.4 | 19.2 | 19.8 | 87.5 | 77.3 |
| 6–24 | " " " | 7.7 | 22.1 | 34.8 | 100.5 | 65.4 |
| 7–8 | " " " | 3.6 | 8.4 | 16.5 | 38.2 | 56.8 |
| 7–21 | " " " | 3.7 | 8.0 | 17.0 | 36.4 | 53.3 |
| 11–4 | " " " | 0.3 | 0.4 | 1.5 | 1.9 | 24.6 |
| 5–23 | Canadian brome | 10.4 | 53.3 | 47.0 | 242.0 | 80.6 |
| 7–11 | " " | 4.2 | 7.7 | 19.1 | 34.9 | 45.3 |
| 5–28 | Kentucky blue grass | 4.1 | 10.2 | 18.8 | 46.2 | 59.0 |
| 6–26 | " " " | 4.0 | 6.2 | 18.2 | 28.2 | 35.0 |
| 7–9 | " " " | 6.3 | 8.0 | 28.8 | 36.4 | 20.9 |
| 7–20 | " " " | 3.6 | 4.1 | 16.5 | 18.5 | 10.8 |
| 11–4 | " " " | 7.2 | 21.4 | 32.6 | 97.2 | 66.6 |
| 5–28 | Little blue stem | 3.8 | 12.2 | 17.2 | 55.2 | 68.9 |
| 6–28 | " " " | 6.7 | 15.6 | 30.5 | 70.8 | 56.9 |
| 7–8 | " " " | 4.5 | 8.1 | 20.4 | 36.7 | 44.5 |
| 7–21 | " " " | 2.7 | 4.3 | 12.3 | 19.7 | 37.8 |
| 6–10 | Buffalo grass | 12.6 | 28.2 | 57.2 | 128.1 | 55.4 |
| 6–23 | " " | 8.6 | 15.9 | 39.3 | 72.1 | 45.5 |
| 7–6 | " " | 4.4 | 6.0 | 19.8 | 27.2 | 30.2 |
| 7–20 | " " | 3.7 | 4.8 | 16.8 | 21.8 | 23.0 |
| 11–6 | " " | 0.7 | 0.9 | 3.0 | 4.2 | 29.3 |
| 6–10 | Red top | 4.0 | 11.3 | 18.2 | 51.3 | 64.0 |
| 6–22 | " " | 3.7 | 6.8 | 16.6 | 30.8 | 46.2 |
| 6–26 | " " | 3.4 | 5.4 | 15.3 | 24.4 | 37.4 |
| 11–6 | " " | 5.7 | 24.1 | 25.9 | 109.2 | 76.3 |
| 6–22 | Alfalfa | 8.8 | 29.2 | 39.7 | 132.6 | 70.7 |
| 7–6 | " | 8.0 | 22.2 | 36.4 | 100.6 | 63.8 |
| 7–22 | " | 3.2 | 8.3 | 14.7 | 37.6 | 60.9 |
| 11–6 | " | 7.1 | 14.3 | 32.1 | 64.9 | 50.5 |
| 6–23 | Dakota brome | 6.2 | 17.8 | 28.3 | 81.0 | 65.0 |
| 7–23 | " " | 3.8 | 6.6 | 17.4 | 30.0 | 42.2 |
| 11–4 | " " | 8.6 | 33.4 | 39.0 | 151.6 | 74.3 |
| 6–25 | Local brome | 7.1 | 15.6 | 32.0 | 71.0 | 54.9 |
| 7–11 | " " | 4.9 | 8.5 | 22.2 | 38.4 | 42.2 |
| 11–13 | " " | 6.6 | 16.7 | 30.1 | 75.6 | 60.2 |
| 6–25 | Orchard grass | 6.8 | 15.2 | 30.8 | 68.8 | 55.2 |
| 7–9 | " " | 6.4 | 12.2 | 29.0 | 55.4 | 47.7 |
| 7–22 | " " | 3.8 | 7.5 | 17.2 | 34.0 | 49.4 |
| 11–13 | " " | 6.4 | 15.4 | 29.2 | 69.9 | 58.3 |
| 11–28 | Wheat | 6.6 | 17.9 | 29.7 | 81.5 | 63.5 |
| 11–28 | Barley | 9.6 | 37.6 | 43.5 | 170.5 | 74.5 |

time of sampling. The work might be criticized for not representing actual pasturage conditions as the plots were not grazed at any time.

After collection the samples were taken immediately to the laboratory and prepared for analysis by cutting as finely as possible with shears.

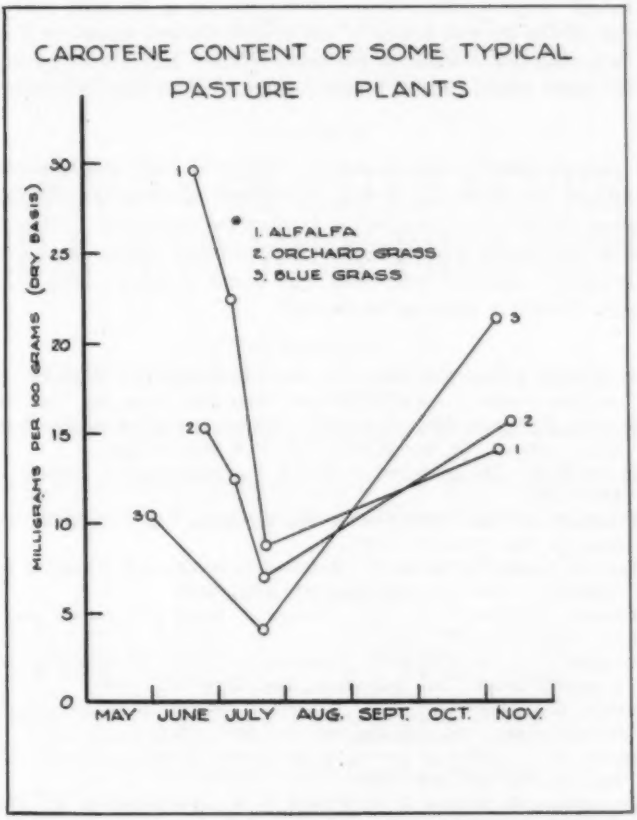



Analysis for carotene was made according to previously described technique (7, 14). Facilities did not make it possible to sample all the plants on the same dates.

## DISCUSSION OF RESULTS

All the pasture plants studied had a relatively high carotene content during the early summer. Seven of the plants sampled between May 22 and June 10 showed a wide range in carotene content, varying from 17.2 mg. of carotene per pound on the fresh basis to 57.2 mg., or a difference of about 300 per cent. Four of the plants—little blue stem (*Andropogon scoparius*),

big blue stem (*Andropogon furcatus*), Kentucky blue grass (*Poa pratensis*), and red top (*Agrostis alba*)—were quite similar, averaging about 18 mg. at that season of the year.




During midsummer (July) most of the plants markedly decreased in carotene content, the exceptions being alfalfa and Kentucky blue grass. The alfalfa represented new growth after a hay crop had been cut. That sample of blue grass was not typical of the conditions for the other plants since it was taken on the college lawn where the grass had been clipped and watered.

Samples taken in November showed very striking differences among the plants in their ability to renew growth and reestablish high carotene values after the fall rains had come. Big blue stem and buffalo grass (*Buchloe dactyloides*) remained brown and naturally cured and were practically devoid of carotene. Most of the other grasses had a carotene content approaching early summer values. These differences in recovery of carotene

content in late fall might be significant in live stock feeding, particularly when the fall grazing period is followed by a long winter feeding of rations low in carotene.

Although these results were obtained during a drought year general knowledge of the growth habits of the plants studied would lend credence to the data obtained. Whether the same relative decrease in carotene during midsummer would prevail under pasturage conditions is problematical.

## SUMMARY

All pasture plants studied showed relatively high carotene values in early summer, but with rather wide variations. During the hot months of midsummer carotene content tended to decrease markedly. After the fall rains most of the plants reestablished their carotene content similar to early summer values. Notable exceptions were found in some plants which were practically devoid in carotene in the fall.

## REFERENCES

(1) Baumann, C. A., and Steenbock, H. Fat soluble vitamins. XXXVI. The carotene and vitamin A content of butter. Jour. Biol. Chem. 101: 547. 1933.

(2) Converse, H. T., and Meigs, Edward B. Vitamin A replaces whole milk in the calf ration. Mimeo. 731, Bur. of Dairy Ind., U. S. Dept. of Agri.

(3) Coward, K. H. The persistence of vitamin A in plant tissues. Biochem. Jour. 19: 500. 1925.

(4) Dutcher, R. Adams. Factors influencing the vitamin content of foods. Penn. Agr. Exp. Sta. Tech. Bul. 275. 1932.

(5) Fraps, G. S., and Treichler, R. Quantitative variations in vitamin A content of butter fat. Jour. Ind. Eng. Chem. 24: 1079. 1932.

(6) Guilbert, H. R., and Hart, G. H. Storage of vitamin A in cattle. Jour. Nut. 8: 25. 1934.

(7) Guilbert, H. R. Determination of carotene as a means of estimating the vitamin A value of forage. Ind. Eng. Chem., Anal. Ed. 6: 452. 1934.

(8) Hart, G. H., and Gulbert, H. R. Vitamin A deficiency as related to reproduction in range cattle. Cal. Agr. Exp. Sta. Bul. 560. 1933.

(9) Krauss, W. E. Effect of pasture on the vitamin A content of milk. Ohio Agri. Exp. Sta. Bul. 470: 149. 1930.

(10) Loy, Edward B., Hilton, J. H., Wilbur, J. W., and Hauge, S. M. The rate of change in the vitamin A content of milk. Jour. Dairy Sci. 20: 31. 1937.

(11) Meigs, E. B., and Converse, H. T. Some effects of different kinds of hay in the ration on the performance of dairy cows. Jour. Dairy Sci. 16: 317. 1933.

(12) Meigs, E. B., and Converse, H. T. Vitamin A in the nutrition of dairy cattle. Proc., 26th Ann. Meeting, Am. Soc. An. Prod., p. 58. 1933.

(13) Palmer, L. S., and Eckles, C. H. Carotene. The principal natural yellow pigment of milk fat, corpus luteum and blood serum. I. The chemical and physiological relation of the pigments of milk fat to the carotene and xanthophylls of green plants. Jour. Biol. Chem. 17: 191. 1914.

(14) Peterson, W. J., Hughes, J. S., and Freeman, H. F. Determination of carotene forage. Ind. Eng. Chem., Anal. Ed., 9: 71. 1937.

(15) Woodward, T. E., and Nystrom, A. B. Feeding dairy cows. U. S. Dept. Agr. Farmers' Bul. 1626. Rev. 1936.

(16) Virtanen, Atturi I. Vitamins and plants. Nature 137: 779. 1936.

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# ABSTRACTS OF LITERATURE ON MILK AND MILK PRODUCTS

## BACTERIOLOGY

**198. A Comparison of Ten Presumptive Test Media Used in the Detection of the Escherichia-Aerobacter Group in Milk.** MICHAEL A. FARRELL, Division of Bacteriology, Penn. State College, State College, Pa. JOURNAL OF DAIRY SCIENCE *20*, 2, p. 67, Feb., 1937.

Brilliant green lactose bile broth, fuchsin lactose broth and methylene blue-brom cresol purple broth were found to be the most efficient of the presumptive media for the detection of Escherichia-Aerobacter. The question was raised whether we possess a reliable medium for the detection of these organisms. J.C.H.

**199. Variants of Streptococcus Lactis Which Do not Ferment Lactose.** E. S. YAWGER, JR., AND J. M. SHERMAN, Cornell Univ., Ithaca, N. Y. JOURNAL OF DAIRY SCIENCE *20*, 2, p. 83, Feb., 1937.

Four cultures of *Streptococcus lactis*, which did not ferment lactose, but were typical in all other respects, were isolated from milk. It is believed that these cultures are naturally occurring variants since one strain after cultivation in milk for ten months, is gradually acquiring the ability to ferment lactose. J.C.H.

**200. Fermentative Variability Among Substrains of Streptococcus Cremoris and Streptococcus Lactis Obtained from Pure Cultures.** J. H. SHERMAN AND R. V. HUSSONG, Cornell Univ., Ithaca, N. Y. JOURNAL OF DAIRY SCIENCE *20*, 2, p. 101, Feb., 1937.

It is doubtful if a differentiation can be founded on the fermentation tests between *S. cremoris* and *S. lactis*. The authors are inclined strongly to believe that *S. cremoris* is a distinct species, and work now in progress leads them to hope that it will be possible, for the first time, to define this organism clearly. J.C.H.

**201. The Detection and Significance of Escherichia-Aerobacter in Milk. III. Correlation of Total Bacterial Count and Presence of the Coli-Aerogenes Group.** M. T. BARTRAM AND L. A. BLACK, Dept. of Bacteriology, Univ. of Maryland, College Park, Md. JOURNAL OF DAIRY SCIENCE *20*, 2, p. 105, Feb., 1937.

These and other results indicate that an accurate test for colon-aerogenes organisms in pasteurized and in certified milk would be a valuable aid in the determination of the sanitary quality of the milk. J.C.H.

**202. Streptococcus Durans** n. sp. JAMES M. SHERMAN AND HELEN UPTON WING, Cornell Univ.,Ithaca, N. Y. JOURNAL OF DAIRY SCIENCE *20*, 3, p. 165, March, 1937.

A more complete description and a new name, *Streptococcus durans* n. sp., was given for a bacterium previously described by the authors. A.C.D.

**203. The Reliability of Selected Tests for the Detection of Mastitis.** A. O. SHAW, H. C. HANSEN, AND RICHARD C. NUTTING, Idaho Agr. Exp. Sta., Moscow, Idaho. JOURNAL OF DAIRY SCIENCE *20*, 4, p. 199, April, 1937.

The milk of cows known to be free from mastitis or to be afflicted in varying degrees was tested to determine the accuracy of the following methods of detecting mastitis, namely the presence of mastitis and hemolytic streptococci, cell count, chloride content, and hydrogen ion concentration.

A.C.D.

**204. Streptococcus Cremoris.** E. S. YAWGER, JR., AND J. M. SHERMAN, Cornell Univ., Ithaca, N. Y. JOURNAL OF DAIRY SCIENCE *20*, 4, p. 205, April, 1937.

An extended description of *Streptococcus cremoris* is given with special emphasis to those characteristics by which it may be distinguished from *Streptococcus lactis*. A.C.D.

**205. Discussion of the Escherichia coli Test to Determine the Efficiency of Pasteurization.** A. R. MACLEAN, Eastern Dairies, Ltd., Montreal, P. Que. Proc. 29th Ann. Conv. Intern. Assoc. of Milk Dealers, Lab. Section, p. 3, 1936.

During a period of eighteen months in 1935 and 1936 using the Brilliant Green Bile (Difco 2 per cent) method as a presumptive test for *Escherichia coli* tests were made upon daily samples taken from normal plant operation. The average of 7,460 tests of 1 cc. milk samples and 2,666 tests of 10 cc. samples showed 99.6 per cent and 96.6 per cent, respectively, as negative. The average of the corresponding highest prevailing average plate counts was 9,470. The use of 1 cc. samples in duplicate and a single 10 cc. sample of pasteurized milk is recommended as a satisfactory modified technic for plant control. The author's experience has been that when the three tubes constituting this technic are all negative the plate count of the sample is almost invariably below 10,000 colonies per cc. The author suggests that his technic might be used as a means of reducing the number of plate counts and yet obtain a more satisfactory insight into the degree of plant sanitation.

E.F.G.

**206. Motion Pictures Showing the Growth of Bacteria (Escherichia coli) from a Single Cell.** MORTON C. KAHN, Cornell Univ., Med.

College, New York City. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 9, 1936.

The value of the moving picture film for the study of the reproduction activities of bacteria is outlined. A reel of film depicting bacterial growth was shown at the session. E.F.G.

**207. Proposed Changes in Standard Methods, Medium and Temperature of Incubation.** A. J. POWERS, Chairman, Standard Methods Committee I. A. M. D. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 38, 1936.

The proposal to change the standard nutrient agar to tryptone-glucose-skimmilk agar and lower the incubation temperature from 37° to 32° C. seemed to warrant a thorough comparison of the two methods by many different laboratories. Seventeen laboratories in 10 states cooperated in making some 25,150 individual plate counts covering a period of 12 weeks commencing about the week of May 12, 1936, on raw, Grade A pasteurized, Grade B pasteurized and cream pasteurized.

The procedure followed is given. The results are reported by the collaborator, Mr. Ernest Kelly. E.F.G.

**208. Report of Collaborator on Cooperative Work with Proposed Changes in Medium and Temperature of Incubation.** ERNEST KELLY, U. S. Dept. of Agr., Washington, D. C. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 50, 1936.

A statistical analysis of 25,150 counts by means of standard agar and tryptone-glucose skim milk agar both at 37° C. and 32° C. is presented. These counts were obtained by 17 different laboratories according to a procedure specified by the Standard Methods Committee I. A. M. D. The following is a partial summary of the extensive tables presented by Mr. Kelly.

Raw milk with standard agar gave higher counts in 82 per cent of the samples with an average increase of 44 per cent in count with plates held 48 hours at 32° C. compared with 37° C. Eighteen per cent of the samples showed a decrease averaging 23 per cent. The net result on all 1,146 samples was an increase of 37 per cent in count at 32° C. over 37° C.

Grade A pasteurized under the same conditions gave increases in 87 per cent of the cases with average increase of 156 per cent and a net increase on all samples of 72 per cent.

Raw milk samples, when plated on tryptone agar and incubated at 37° C., gave higher counts in 68 per cent of the samples with an average increase of 74 per cent as compared with standard agar. The 32 per cent of the samples which showed a decrease for tryptone agar decreased 84 per cent leaving a net decrease with 1,157 samples of 7 per cent for tryptone agar at 37° C.

Grade A pasteurized milk under these conditions gave an increase in 70 per cent of the cases with an average increase in count of 91 per cent and a net increase for all samples of 46 per cent.

Raw milk samples with standard agar at 37° C. compared with tryptone agar at 32° in 87 per cent of samples gave an average increase of 68 per cent with the latter. Thirteen per cent of the sample decreased 40 per cent with tryptone agar leaving a net increase for 1,142 samples with tryptone agar at 32° C. of 59 per cent.

Grade A pasteurized milk gave an increase with tryptone agar at 32° C. compared with standard agar at 37° C. in 89 per cent of the instances with an average percentage increase in count of 237 and a net increase in 1,051 samples of 120 per cent.

Results of the same general trend are given for Grade B pasteurized milk and pasteurized cream with the greatest increase for the new technic in the case of pasteurized cream. Greater percentage increases were also generally obtained in milk and cream with the lower counts.

The increase due to the substitution of tryptone agar for standard agar at 37° C. was the least potent factor tried, but results in a fairly uniform increase of about 50 per cent in all products.

Lowering the temperature of incubation from 37° C. was the greatest single factor in increasing counts irrespective of the culture media used.

A combination of tryptone agar medium and incubation at 32° C. had the greatest effect in increasing the count of all products examined.

E.F.G.

**209. Comments on Possible Influence of Variations in Laboratory Technic.** J. F. Cone, U. S. Dept. of Agr., Washington, D. C. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 75, 1936.

Referring to the tabulations of results of comparison of standard plate method and tryptone agar at 37° C. and 32° C. by 17 laboratories under the direction of Standard Methods Committee the variations in incubator temperature, agar temperature at pouring, pH of media and colonies per plate were discussed. E.F.G.

**210. Differential Value of a Milk Medium Containing at Least Two Per Cent of Skimmilk.** C. N. Stark, Cornell Univ., Ithaca, N. Y. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 82, 1936.

The addition of 2 per cent skimmilk to agar has given 2 to 4 times as high a count as was obtained on standard agar and the colonies were larger and easier to count. The presence of lactic acid producing bacteria and casein digesting bacteria could also be detected without the expense of using an additional medium. The addition of skimmilk should be given consideration when changing the standard medium. E.F.G.

**211. Sources of Milk Solids for Use in Modified Media.** ALEC BRADFIELD, Vermont Agr. Exp. Sta., Burlington. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 94, 1936.

Examination of 665 samples of raw milk with tryptone-glucose skimmilk agar suggested by Bowers and Hucker and incubated at 32° C. showed a higher count in 88 per cent of the cases than when plated on standard nutrient agar and incubated at 37° C. In pasteurized milk increased counts occurred in 94 per cent of the instances. Udder flora did not develop appreciably larger numbers of colonies.

No significant difference in numbers of colonies developing on plates were found when using fresh skimmilk, milk flakes or spray powder at the rate of 0.5 per cent calculated as liquid milk in the above modified media although vacuum drum and roller methods gave less satisfactory results because of more variation Adding reconstituted milk or dry milk solids were equally satisfactory and fresh skimmilk appeared to have no advantage.

E.F.G.

**212. Coli Bacilli and Coliphages in Infants.** ERENE LIPSKA. Biochemical Laboratory, School of Hygiene, Warsaw, Poland. Le Lait *16*, 153, March, 1936.

The coli bacilli isolated from the excrement of 42 infants exhibited biochemical properties intermediate between those originating from feces and those originating from milk. Coli bacilli from the excrement of well and sick infants were alike in their biochemical reactions. The filtrates from excrement of infants were less active for bacilli of the colon typhoid group and for dysentery bacteria than were filtrates of milk. The filtrates from excrement from sick infants were less active for the bacteria studied than were those from well infants. The activity of the filtrates studied extended at the most to 10 stocks. The more active bacteriophages formed on gelose slants in areas of 1 to 2 millimeters in diameter. The various biochemical reactions studied were the following: glycerol, sorbitol, dulcital, raffinose, sucrose, salicin, fluorescence of neutral red, coagulated milk, hydrogen sulphide, indole, Voges-Proskauer, sodium citrate, and sodium propionate.

A.H.J.

**213. On the Probability of Pure Culture Isolation fro a Petri Plate.** T. MATUSZEWSKI AND J. SUPINSKA, Inst. F. Gärungsgewerbe u. landw. Bakt. b. Museum f. Gew. u. Landw., Warschau and J. Neyman, Abtlg. f. angew. Statistik d. Univers. London. Zentr. Bact. II, *95*, p. 45, 1936.

The authors tried to determine how great is the probability that a single colony picked out from an agar plate is really derived from a single cell. The mathematical methods used were the formulas of Poisons law and the tables of Elderton. It could be shown that the values depend (1) on the

size of the colonies, (2) on the number of colonies, (3) on the size of the plate. A table is given to show the probability of securing a colony derived from a single cell, if there are different initial conditions. A further table gives corrections to determine from these values the real number of originally suspended individual bacteria per colony. K.J.D.

**214. Foul, Stringy Milk.** O. LAXA, Prag. Zentr. Bact. II, *95*, p. 125, 1936.

The author explains a special ropy fermentation where not only the consistency but also the flavor of milk has been materially affected. The milk was very stringy, soured slowly and afterwards acquired a bad smell, which later resembled trimethylamine. The cream separated as a foamy layer on the milk. The causative organism was named *Viscobacterium lactis foetidum* (1.5 μ long and 1 μ broad, with distinct capsules). Its cultural and physiological characteristics are given. Besides the above mentioned properties it may be emphasized that $CO_2$ is developed from lactose and that the slime is formed from proteins or amines and not from carbohydrates. K.J.D.

**215. Studies on Bacterium Herbicola.** E. MACK, Milchw. Forschungsanstalt in Kiel. Zentr. Bact. II, *95*, p. 218, 1936.

An extensive study was made of numerous strains of *Bacterium herbicola*. They could be secured regularly from small fleshy plants, less regularly from trees and bushes. All strains showed identical characteristics, morphologically, and physiologically. There is no kinship to Bergey's *Flavobacteria* except *Flavobacterium trifolii*. The latter is named by the author "*Flavobacterium herbicola*, Burri et Düggeli." It could not be shown that there is any life cycle relationship between *Bact. herbicola* and Coli-organisms or between *Bact. herbicola* and *Streptococcus lactis* as Hüttig tried to demonstrate some time ago. The behavior in milk is the following: Only a few strains are able to ferment lactose (weak acid and strong slime formation). Generally milk remains unchanged a long time except for the formation of a tough yellow skin on the surface. There is no visible protein decomposition, the milk, however, acquires a bitter taste after a few days. At higher temperature milk is curdled by rennet formation. The determination of Amino-N (after Van Slyke) revealed a weak protein decomposition. There is no fat hydrolyzation. All strains are killed by holding pasteurization. At room temperature *Strept. lactis* is a strong antagonist of *Bact. herbicola*, but not at refrigerator temperature. K.J.D.

**216. Transformation of Streptococcus lactis (lacticus, acidi lactici) into Streptococcus faecium (faecalis, Enterococcus).** W. STORCH, Milchw. Forschungsanstalt in Kiel. Zentr. Bact. II, *95*, p. 284–310, 1936.

These experiments were performed to show if there is any closer relationship between the *Streptococcus lactis* and *Streptococcus faecium*, since this

is the opinion of some authors of former and recent years (Kruse, Ayers and Johnson, Gundel, Demeter). The method used to show this was to treat typical *S. lactis* strains culturally in such a way that they might acquire the characteristics of *S. faecium*. The transformation experiments by passages in milk, peptone-milk, mash and peptone-mash + rye-decoct were only partially successful, since the transformations did not prove to be constant. A further passage in alkalinized mash + oxgall did not improve the constancy of the transformation. Good results, however, were achieved by heating the *S. lactis* strains twice to 63° C. for 15 minutes. Treating *S. lactis* strains analogous to the conditions in the human alimentary tract also gave positive results under certain conditions. It looks as if the enzymes promote the transformation ability of *S. lactis* into *S. faecium*. K.J.D.

**217. On Relations Between Pork Raising and the Occurring of Lactic Acid Streptococci in Milk and Dairy Products. The "Ordinary" Lactic Acid Bacterium.** F. BANG, Milchw. Forschungsansalt in Kiel. Zentr. Bact. II, *95*, p. 390, 1937.

The development of lactic acid bacteria in the intestines of old and young pigs is incomparably easier than in the alimentary tract of cows and calves. *Streptococcus lactis* is able to grow in the intestinal canal of pigs, but not in cows. This is true, however, only if the pigs have been fed with cow's milk. Sucking pigs, on the other hand, do not harbor *S. lactis*. Air analyses of cow and pig stables demonstrated, that the pig stables are the veritable contamination sources of those lactic acid streptococci, which show a striking development in milk. There were only a few such streptococci found in the air of cow stables, if the latter were located far away from pig stables or from other farm buildings. *S. lactis* does not like to initiate growth on agar plates exposed to air, it is better to secure the organism on milk tubes by the method of the author. K.J.D.

**218. The New Proposed Procedure for Making Ice Cream Plate Counts.** A. H. ROBERTSON, N. Y. State Dept. of Agr. and Markets, Albany, N. Y. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. 2, p. 132, Oct., 1936.

This is a report of comparisons made in five different ice cream plants between bacteria counts obtained by the use of standard nutrient agar and with tryptone-glucose agar at both 32° and 37° C. The tryptone-glucose agar was found to give definitely higher bacteria counts than standard nutrient agar. The higher count with tryptone-glucose agar is thought to be a more accurate criterion of the actual number of organisms present in ice cream than is the count secured with standard nutrient agar.

As to the incubation temperature, duplicate counts from the same dilution waters have been shown to be from 30 to 50 per cent less variable at 32° C. than at 37° C.

If the American Public Health Association should adopt tryptone-glucose agar as the official standard medium, this study would give the ice cream maker an idea of the effect of such a change on the total bacterial counts of ice cream. M.J.M.

## BUTTER

**219. A Study of the Several Minnesota Reagents for the Determination of Fat in Buttermilk.** E. W. Bird and D. F. Breazeale, Iowa State College, Ames, Iowa. Journal of Dairy Science *20*, p. 1, Jan., 1937.

The fat content of buttermilk as determined by the Minnesota reagent was found to vary according to which one of the three suggested reagents was used. A.C.D.

**220. A Study of the Churn Cleaning Methods Used by Plants Producing Butter of Various Yeast and Mold Counts.** H. A. Bendixen, State College of Washington, Pullman, Washington. Journal of Dairy Science *20*, 1, p. 15, Jan., 1937.

Low yeast and mold counts in pasteurized cream butter indicated proper methods of churn sterilization which consisted of the use of churn wash water at 82–94° C. (180–201° F.) with total volume of $\frac{1}{3}$ to $\frac{1}{2}$ of the churn capacity, washing for 15 minutes, and rinsing with hypochlorite solution of 50 p.p.m. of chlorine or rewashing with hot alkaline wash water. A.C.D.

Other abstracts of interest are numbers 199, 200, 204, 205, 216, 222, 224, 225, 226, 227, 230, 234, 282, 283, 285, 288, 308, 311, 313, 314, and 318.

## CHEESE

**221. Determination of Fat, Moisture, and Salt in Hard Cheese.** G. H. Wilster, W. V. Price, A. J. Morris, E. F. Gross, G. P. Sanders, Oregon State Agr. College, Corvallis, Oregon. Journal of Dairy Science *20*, 1, p. 27, Jan., 1937.

The authors gave specific directions for analyzing cheese for fat, moisture, and salt. A.C.D.

## CHEMISTRY

**222. Concerning the Theory of the Electrical Deacidification of Milk.** Otto Gratz. Le Lait *16*, 156, p. 611, June, 1936.

It is suggested that the theory of the electrical deacidification of milk put forth by Pien and Baisse (Journal of Dairy Science, Abstracts, 19, 213, 1936) may not be correct. Gratz concludes that lactic acid is electrolyzed, the acid salts of the milk being converted to a basic form. A.H.J.

**223. Observations Concerning the Action of the Calcium Chloride Solution Used in the Preparation of Milk (to which alkaline carbonates have been added) for Refractiometry.** A. TAPERNOUX, Vet. School at Lyons, France. Le Lait *16*, 158, p. 832, Sept.-Oct., 1936.

The solution used for clarifying milk to be used for the determination of the refractive index consists of 200 grams of calcium chloride made up to one liter with water. To 30 cc. of milk is added the proper amount of the above solution (usually 0.20 to 0.25 cc.). After shaking vigorously the solution is held at boiling temperature for 15 minutes. Usually the curd separates from the milk when subjected to this procedure and a clear liquid separates which is used in determining the refractive index. Occasionally the liquid thus obtained is not clear but is turbid and excessive foaming occurs during the preparation of the liquid. The addition of such alkaline substances as sodium bicarbonate, sodium carbonate, lithium carbonate and ammonium carbonate to the milk resulted in the obtaining of cloudy filtrates. It is therefore suggested that cloudy filtrates are obtained when the milk has been neutralized in processing. The addition of such preservatives as formalin or potassium dichromate to the milk did not affect its characteristic behavior with the calcium chloride solution. A.H.J.

**224. The Viscosity of the Fatty Matter in Butter.** M. GORIAEW, Engineering Inst. of the Milk Industry, Leningrad, U.S.S.R. Le Lait *16*, 159, p. 943, Nov., 1936.

Determinations of the viscosity of the fatty matter of butter were made at 10° intervals between 30 and 100° C. (86 and 212° F.) inclusive. The viscosities in poises were respectively as follows: 0.258, 0.173, 0.124, 0.093, 0.071, 0.059, 0.049, 0.042. The cinematic viscosity (viscosity divided by the density at that temperature) and the fluidity of butter fat at these temperatures were calculated. The fluidity of butter fat was shown to be a linear function of temperature between 50 and 100° C. (122 and 212° F.) At 30° C. (86° F.) determinations of the viscosity of butter fat became more complicated because of the slow and partial solidification of the glycerides. For this reason the determination of the viscosity at temperature below 30° C. (8°6 F.) is not favored. A.H.J.

**225. The Influence of the Physical State of the Fat on the Calculation of Solids from the Specific Gravity of Milk.** PAUL F. SHARP AND RAY G. HART, Dept. of Dairy Ind., Cornell Univ., Ithaca, N. Y. JOURNAL OF DAIRY SCIENCE *19*, 11, p. 683, Nov., 1936.

It is necessary to warm milk to 113° F. followed by prompt cooling to 60° F. before determining its specific gravity or the results will not be constant due to the variable condition of the milk fat. A.C.D.

**226. The "Transition Point" of Milk Fat.** G. A. RICHARDSON, Univ. of California, Davis, California. JOURNAL OF DAIRY SCIENCE *19*, 12, p. 749, Dec., 1936.

Milk fats produced under different feeding conditions have characteristic "transition points." A.C.D.

**227. Mercuric Chloride as a Preservative for Milk Samples Held for the Determination of Lactic Acid.** H. C. TROY AND PAUL F. SHARP, Dept. of Dairy Ind., Cornell Univ., Ithaca, N. Y. JOURNAL OF DAIRY SCIENCE *20*, 2, p. 77, Feb., 1937.

Milk samples can be preserved satisfactorily for lactic acid determination up to one month when not less than 0.5 per cent of mercuric chloride is added, followed by heating the sample to 80° C. for 5 minutes, then cooling and holding at 20° C., or lower, preferably in the dark. J.C.H.

**228. A Simple Plant Method of Estimating the Alkaline Constituents of Washing Powders and Washing Solutions Containing Mixed Alkalies.** LAWRENCE L. LITTLE, Meadow Gold Milk Plant, Oklahoma City, Okla. JOURNAL OF DAIRY SCIENCE *20*, 2, p. 93, Feb., 1937.

A method is proposed for the analysis of a washing powder containing any or all of the cleaning alkalies—caustic soda, soda ash, trisodium phosphate and sodium meta silicate. J.C.H.

**229. Some Factors Influencing Fat Content in Ice Cream Mix and the Corresponding Finished Ice Cream as Determined by the Mojonnier Method.** J. J. JOHNSON AND J. I. ORMOND, Sealtest System Lab., Baltimore, Md. JOURNAL OF DAIRY SCIENCE *20*, 3, p. 159, March, 1937.

Excessive shaking of melting ice cream samples caused fat separation which produced erratic variations in fat tests with a tendency toward low results. A.C.D.

**230. The Oxidation of Butterfat. I. The Catalytic Effect of Light, V.** C. STEBNITZ AND H. H. SOMMER, Dept. of Dairy Ind., Univ. of Wisconsin, Madison, Wis. JOURNAL OF DAIRY SCIENCE *20*, 4, p. 181, April, 1937.

Dark green and dark red wrappers were most effective in screening out the ultra-violet light which accelerated the oxidation of butterfat. A.C.D.

**231. A Simple Method for the Detection of Copper in Alloys.** B. L. HERRINGTON AND JOHN G. BRERETON, Dept. Dairy Ind., Cornell Univ., Ithaca, N. Y. JOURNAL OF DAIRY SCIENCE *20*, 4, p. 197, April, 1937.

A simple test paper method is given by which the presence of copper in alloys can be easily detected. A.C.D.

**232. Comparison of Potentiometric and Colorimetric Methods of Determining the hydrogen ion Concentration of Nutrient agar.** JOSEPH S. TAYLOR, Supplee-Wills-Jones Milk Co., Philadelphia, Pa. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 86, 1936.

Three agars were used; No. 1, unneutralized; No. 2, neutralized with 5 cc. of 0.2N NaOH per 400 cc.; No. 3 neutralized with 10 cc. 0.2N NaOH per 400 cc.

It was found that the pH as determined colorimetrically ran quite consistently 0.2 pH lower than the potentiometric value. There was no consistent difference in the counts and unneutralized agar is considered satisfactory. The colorimetric method is sufficiently accurate and has the advantage of ease and simplicity. E.F.G.

## CONCENTRATED AND DRY MILKS

Abstracts of interest are numbers 203, 205, 207, 208, 209, 210, 211, 222, 228, 231, 235, 276, 282, 296, 307, 308, 311, 312, 313, 315, and 316.

## FOOD VALUE

**233. American Medical Association Takes Stand on Vitamin D Question.** Milk Dealer *26*, 5, p. 51, Feb., 1937.

Milk is the only common food which will be considered for acceptance by the American Medical Association when fortified with vitamin D, according to a decision by the Council on Foods of the American Medical Association. Requirements and allowable claims for vitamin D milk that may be made on bottle caps bearing the approval of the American Medical Association are also given. C.J.B.

**234. The Transmission of Vitamin A from Parents to Young in Mammals. V.** The Vitamin A and Carotenoid Contents of Human and Colostrum milk. WILLIAM JOHN DANN, Dept. of Physiology and Pharmacology, Duke University School of Medicine, Durham, N. Y. Biochem. J. *30*, 1644, 1936.

Single samples of colostrum from 111 women and single samples of early milk from 104 of the women on uncontrolled relatively poor diets during pregnancy and after delivery, were examined for vitamin A and carotenoid content, employing for the tests, respectively, the Carr-Price method and the Lovibond tintometer.

According to a previous report on the milk of shorthorn cattle, the mean figures for cows' colostrum were 1253 B (Blue units) of vitamin A and 447 Y (Yellow units) of carotene per 100 ml. giving a total estimated biological

activity of 1055 I.U. per 100 ml. For the cow's milk, the corresponding figures were 30 B of vitamin A and 20 Y of carotenoids per 100 ml., giving a biological activity of 35 I.U. per 100 ml. The mean values for human colostrum are 629 B of vitamin A and 305 Y of carotenoids per 100 ml., giving an estimated biological activity of 632 I.U. per 100 ml. For human milk the corresponding values are 410 B of vitamin A and 120 Y carotenoid per 100 ml., giving an estimated biological activity of 346 I.U. per 100 ml. Thus the samples of human colostrum examined in this study average about half as much vitamin A and three-quarters as much carotenoids as the cow's colostrum; the total estimated activity being about three-fifths as great. On the other hand, the human milks were much richer than the cow's milks; they contained on the average about fourteen times as much vitamin A and about 6 times as much carotenoids and their biological activity was about ten times as great.

Since the ratio of concentration of vitamin A in human colostrum to concentration in human milk is small relative to the ratio for the cow (the mean figures being respectively 2.7 and 35) and since the volume of colostrum in the human subject is small, it appears human colostrum has no special function to perform in providing a special reserve supply of vitamin A for the infant at birth. K.G.W.

**235. A Simplified Procedure for Calculating Weights of Milk to Their Energy Equivalent in Milk of Different Fat Content in Accordance with the Gaines Formula.** A. E. PERKINS, Ohio Agr. Exp. Sta., Wooster, Ohio. JOURNAL OF DAIRY SCIENCE *20*, 3, p. 129, March, 1937.

The author presents a simplification of the Gaines' Formula for calculating milk to the energy equivalent of milk containing four per cent of fat. A.C.D.

## ICE CREAM

**236. Know Your Ice Cream.** ROBERT C. HIBBEN, Intern. Assoc. Ice Cream Mfgrs., Washington, D. C. March, 1936.

This booklet is a presentation of important points in the manufacture of commercial ice cream. It is written in popular style and explains simply the various processes through which the product goes while being made into the finished product.

The booklet can be bought in quantity from the Ice Cream Merchandising Institute, 1105 Barr Building, Washington, D. C. M.J.M.

**237. President's Address.** C. F. SAXON, President Controller's Council, I. A. I. C. M., French Bauer, Inc., Cincinnati, Ohio. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *3*, p. 7, Oct., 1936.

A high degree of managerial skill and intelligence is essential for progress

under present day business conditions. There is no substitute for the scientific method of exact inquiry as a basis for making decisions. The accountant must learn to use the methods of experimental and statistical inquiry as an aid in solving problems in management.

The program for the controller's council is a discussion of modern methods of statistical inquiry, relative costs, and trends in accounting.

M.J.M.

**238. The Year's Activities.** O'NEAL M. JOHNSON, Statistical and Accounting Bureau, Intern. Assoc. Ice Cream Mfgrs., Washington, D. C. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *3*, p. 8, Oct., 1936.

A demand for information as to trends in costs resulted in the publishing of Special Bulletin No. 53, entitled "Trends in Costs," by the International Association of Ice Cream Manufacturers. The Association has conducted an analysis of trucking costs, as well as Advertising and Package Analysis. These reports will be published soon.

The ice cream sales index figures have also been determined. A summary of these result is as follows:

| | 1936 compared with 1935 | |
|---|---|---|
| | United States per cent | Canada per cent |
| May | +39.56 | +35.95 |
| June | +23.49 | +15.89 |
| July | +19.33 | + 4.13 |
| August | +19.42 | − 1.16 |
| May to Aug., Inc. | +24.06 | +10.31 |
| Jan. to Aug. " | +20.64 | + 9.82 |

M.J.M.

**239. Why Accounting?** O'NEAL M. JOHNSON, Statistical and Accounting Bureau, Intern. Assoc. Ice Cream Mfgrs., Washington, D. C. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *3*, p. 12, Oct., 1936.

Business accounting originally was a record of accounts receivable which could be used as a basis for collecting accounts. Gradually there developed from this the practice of keeping a record of accounts payable. The next addition to this was a record of all assets and liabilities and consequently, the preparation of a balance sheet with the resulting profit and loss statement was made possible.

The first big impetus to accounting was from the imposition of the income tax. Reasonably good accounting became necessary so that income, cost of sales, and expenses could be shown. Cost accounting has developed better business for accurate information as to products cost, manufacturing costs, delivery, sales, and distribution costs are now available. This information is

essential if the various costs are to be kept in line and costs are to be controlled. Recent Federal legislation, such as compensation insurance, old age annuities, the Robinson-Patman Law, etc., has placed a premium on good accounting. M.J.M.

**240. Experience with the Association Accounting System.** GEORGE F. MILLER, Miller Dairy Farms, Eaton Rapids, Mich. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *3*, p. 19, Oct., 1936.

A description is given of the accounting needs in this particular business consisting of a dairy farm, an ice cream and milk plant, wholesale accounts, and several retail stores. The Accounting System of the International Association of Ice Cream Manufacturers proved very satisfactory and especially helpful in checking on the accounts of the retail stores which, previous to the installation, was extremely difficult. M.J.M.

**241. Customer Costs.** C. F. SAXON, French-Bauer, Inc., Cincinnati, Ohio. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *3*, p. 49, Oct., 1936.

There are few ice cream manufacturers who could not increase their sales by an increase in sales expense, but there is a point beyond which it is unprofitable to increase advertising costs. The analysis of distribution costs by customers may offer an answer to the question of where and how to sell at a profit. Such an analysis should reveal the unprofitable as well as the low cost accounts. Consumer's costs should reveal where and how to sell at a profit.

The method by which the distribution costs by consumers can be determined is as follows:

1. Credit each customer with the gross margin produced from his business.
2. Deduct the costs of the functions securing this gross in the following order:
    a. Route delivery costs
    b. Special delivery cost
    c. Cabinet service
    d. Cost of personal selling
    e. Advertising
    f. Sales department overhead
    g. General company overhead
3. The foregoing information should show:
    a. Whether a satisfactory gross is produced
    b. At what point the gross will fail to cover its cost

The difficulties of analyzing distribution costs are great. The field is new and little standardized practice has been developed. The method of securing customer's costs as outlined should prove to be a better method than some others in ascertaining where and how to secure profitable gallonage. M.J.M.

**242. The Trend in Trucking Costs.** R. E. SLONAKER, Philadelphia Dairy Prod. Co., Philadelphia, Pa. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *3*, p. 51, Oct., 1936.

There are three types of routes which should be considered:

1. Peddle routes
2. Combination peddle and telephone
3. Telephone call order routes

A comparison of costs by the three systems shows that in 1932 by the peddle system the delivery cost was 18.05 cents and for 1935, 13.93 cents.

For the second system the 1932 cost was 10.87 cents per gallon and in 1935 it was 8.22 cents per gallon.

For the third system the cost per gallon in 1932 was 6.75 cents per gallon and in 1935, 7.22 cents per gallon.

The call order system is, therefore, cheapest in large cities where population is dense, telephone costs per call are low, and trucking routes are short. However, for the plant located in a small town many of the calls would be toll calls. In this case one of the other types of routes should be cheapest.

During the past few years the amount of packaged goods and novelties has increased. This change has reduced the pay load approximately twenty per cent during the peak season.

The more general use of mechanical cabinets in recent years has made possible the use of lighter trucks, the lengthening of routes, and combining of routes. These changes have lowered trucking costs. The use of mechanically refrigerated trucks and the elimination of metal cans have also lowered trucking costs.

For 1932 the average delivery cost per gallon for the entire company was 9.56 cents while in 1935 the cost was 8.19 cents per gallon, a saving of more than one cent a gallon.

Discussion, led by P. B. Beck, The Borden Co., New York, N. Y.

A graphic chart, showing the change in trucking costs from 1930 to 1936, was discussed. The chart showed a gradual decrease in trucking costs from 1930 to 1936. M.J.M.

**243. The Merchandising Council's Activities in 1936.** JAMES H. MEEHAN, Pres. Merchandising Council I. A. I. C. M., Philadelphia Dairy Prod. Co., Philadelphia, Pa. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *4*, p. 7, Oct., 1936.

The function of the Merchandising Council is to act as advisor to the Ice Cream Merchandising Institute.

The Ice Cream Merchandising Institute has presented an extensive line of point of sale advertising materials which have been used by many ice cream manufacturers. The institute has also urged the standardization

of fountain services. A program of consumer publicity and public relations is planned by the institute. Publicity releases will be issued at bimonthly intervals. Research to determine the consumer attitude toward ice cream will be attempted.

The Merchandising Institute is preparing for sale a manual which deals with various phases of merchanding ice cream.. M.J.M.

**244. A Layman's View of the Ice Cream Business.** JERRY MCQUADE, Editor, Drug Topics, New York, N. Y. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *4*, p. 12, Oct., 1936.

Many companies are merchandising their products through the medium of the drug store. The ice cream industry has not kept pace with many other industries in aiding the druggist to sell its product, according to the author. He suggests a more active sales program on the part of the ice cream industry. Cooperation with the druggist in making birthday and holiday specials, in distributing recipe booklets, and in the promotion of special sales is urged. M.J.M.

**245. Ice Cream's Value to Fountain Profits.** A. B. HOPPE, Loft's Inc., New York, N. Y. Proc. 36th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *4*, p. 19, Oct., 1936.

Ice cream must be considered as a perishable product. Therefore the merchandising of ice cream offers a special problem in comparison with packaged goods. The ice cream manufacturer should educate the operator of the soda fountain to the special problems arising in the dispensing of this product so that reasonable returns are realized. The soda fountain can be made to return a net profit of 15 cents on the dollar to the druggist if the fountain is properly managed. M.J.M.

**246. The Ice Cream Manufacturer's Responsibility to his Dealers.** A. H. DEWEES, N. W. Ayer and Sons, San Francisco, Calif. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *4*, p. 25, Oct., 1936.

Selling methods and advertising materials which should prove helpful to the ice cream dealer are discussed in detail in this paper. M.J.M.

**247. Retail Stores—Yes or No.** Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *4*, p. 48, Oct., 1936.

A discussion led by Louis J. Wainer, Penn. Dairies, Inc., Lancaster, Pa.

Whether or not retail ice cream stores should be operated depends largely on the specific local conditions of the market. The principal advantages of the retail store are as follows:

1. The retail store is a controlled outlet.
2. There is a positive control of the product.
3. A well-kept store in a new territory opens up a new market.

4. The retail store does not increase your sales expense.
5. Since the retail store is equipped for large gallonage, cabinet expense is lowered.
6. Advertising cost on a gallon basis is lower.
7. The retail store furnishes a medium for studying the selling of ice cream.
8. The retail store increases volume.
9. Per consumption of ice cream is increased by the retail store.

The principal disadvantages of the retail store are:

1. Securing a satisfactory location is absolutely essential.
2. Water and electrical costs are high.
3. Efficient individual store management is necessary.
4. Difficulty of finding suitable fountain employees.
5. Legislation in some states is detrimental.
6. The net return per gallon of ice cream is low.
7. A large volume must be sold through each store.
8. Many operating costs are increased.

(a) Benjamin C. Brown
New Orleans Ice Cream Co., New Orleans, La.

The retail store can be operated successfully only if the community selected is suitable, if rent is fair, if the spending power of the people is favorable, and if satisfactory prices can be obtained.

The present wholesale stops being serviced must be seriously considered. The idea of competing with one's established customers is a problem which must be solved.

(b) Jos. Morrissey
De Coursey Creamery Co., Kansas City, Kansas

The retail druggists and dealers have been the backbone of the ice cream industry. The retail dealer may not have put forth the same effort in selling ice cream as he has with other products. The ice cream store has given the ice cream manufacturer a greater incentive to push ice cream sales. With the low cost of raw materials these stores have flourished because of large servings, big value and the public price consciousness. But with higher material costs and other fixed costs the retail ice cream store will become unprofitable and the ice cream industry again will have to rely on retail dealers for profitable outlets.

(c) Kenneth C. Poole
Frostkist Ice Cream Co., Portland, Oregon

The ice cream manufacturer is going into a field with which he is unaccustomed when he opens retail stores. Additional capital must be provided and a reserve set up for various contingencies. The cost of retailing in the food field is comparatively high. It is generally conceded that failures are more common in the retail business than in wholesale production.

The wholesaler who has survived changing business conditions is advised to stay out of the retail field. However, if he decides to retail his product, then he should forget the wholesale business, employ a staff of retail merchandisers, and change his merchandising methods completely. M.J.M.

**248. Packages and Individual Services vs. Bulk Ice Cream.** Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *4*, p. 64, Oct., 1936.

A discussion led by Frank A. Carroll, Pittsfield Milk Exchange, Pittsfield, Mass.

The main advantages of packages and individual services are, (1) the brand can more effectively be identified by the consumer, (2) advertising is more effective, (3) the profit is fixed, (4) a more sanitary product is sold, (5) service is easier and faster, and (6) the dealer can carry a greater variety of kinds and flavors when the ice cream is packaged.

Bulk ice cream is still preferred by the majority of people. Another disadvantage is that ice cream shrinks in packages. Often the overrun is too high in packaged ice cream. Bulk ice cream is also easier to make and is more profitable.

(a) A. C. Routh, Esmond Dairy Company, Sandusky, Ohio

In present day competition survival in business is impossible with the sale of bulk ice cream alone. Furthermore, it is impossible now to divert business back to bulk ice cream because many types of retail packages are widely accepted by the consumer. The distribution of individual units of ice cream is advisable because people like novelty and novelties, and unit production is the only means by which the dealer can control size, quality, and prices to both dealer and consumer.

(b) George Sanderson, Haines-CeBrook Company, Lynn, Mass.

In 1935 equipment was installed in our business for making the "Rol Form" of individual service. This has measured up in every way with expectations. The gallonage of our dealers has increased; a substantial number of new accounts have been added; and dealers as well as customers are satisfied with the new form of product.

(c) G. G. Diffenbach, Abbotts Dairies, Inc., Philadelphia, Pa.

Bulk as well as packaged ice cream must be sold by any well organized business. However, consumers do prefer bulk ice cream as is evident from the fact that 15 per cent of sales is represented by packaged ice cream and the other 85 per cent is bulk. From 1926 to 1931, the percentage of package sales to total sales of ice cream for the entire country increased only 1.82 per cent. During those five years much effort was put forth to sell ice cream in packages. From this it is evident that the consumer resists the sale of ice cream in packaged form.

(d) Humphrey Daniel, Carry Ice Cream Company, Washington, D. C.

There are several reasons why the public prefers bulk ice cream: A dipped package is heavier than a plant filled package. Bulk is only frozen once, hence is smoother in texture than packaged ice cream which is frozen more than once. Bulk ice cream is higher in temperature when served and therefor better flavored. The ice cream manufacturer should realize the wisdom of centering his activities around bulk ice cream. He should help his dealers merchandize bulk ice cream by advertising and teach them to dispense ice

cream in such a way that satisfactory profits are realized. Time taken to pack bulk is compensated for in that the consumer is getting a product which he prefers and will buy more often.

It is wise to gather extra gallonage where it can be had by selling packages and individual services, but not when they displace the more profitable and consumer pleasing bulk. M.J.M.

**249. The Importance of the Fat Globule Membrane in the Freezing of Ice Cream.** C. D. DAHLE AND D. V. JOSEPHSON, Penn. State College, State College, Pa. Proc. 36th Ann. Conv. Int. Assn. Ice Cream Mfgrs. *2*, p. 100, Oct., 1936.

It is well known that ice cream mixes made from butter, butter-oil, plastic and frozen creams as fat sources exhibit inferior whipping properties when compared to mixes in which sweet cream is the source of the butterfat. It has also been demonstrated that the addition of certain substances such as dried egg yolk, buttermilk or buttermilk powder to mixes containing butter decreases the time required to reach a definite overrun.

The purpose of this investigation was to determine the reason for the poorer whipping properties of ice cream mixes made from butter, butter-oil, frozen cream and plastic cream; and by definite experimental evidence, to point out the factors which are responsible for this inferior whipping ability.

The explanation for the above was found in the nature of the fat globule membrane surrounding the fat globule, consisting of a protein-phospholipid complex, which is essential for normal whipping of ice cream mixes.

Studies of "oiling off" in butter, frozen cream and plastic cream mixes showed that the fat separation in these mixes was responsible for their poor whipping properties. The whipping ability of these mixes was restored to normal by reestablishing the normal membrane directly on the surface of the fat globules. The beneficial effect of egg yolk on whipping was also found to be a fat globule surface phenomenon. Egg yolk and fat globule membrane material are both protein-phospholipid complexes, which undoubtedly accounts for their similar effects on whipping.

The plasma constituents of milk were found not to aid the whipping ability of butter mixes nor was the emulsifying of butter in skimmilk prior to its incorporation into the mix of any benefit. The addition of the fat globule membrane suspension, however, restored the whipping ability of butter mixes to normal.

The authors draw the following conclusions from their investigation:

1. The whipping ability of ice cream mixes made from butter, frozen cream, and plastic cream, is directly related to the degree to which the mixes "oil-off" during processing.

2. The cause for the poorer whipping properties of mixes which "oil-off" is that probably during the reemulsification of the fat, foreign membranes

are established on the surfaces of the newly-formed globules. These membranes are composed of a mixture of all of the surface-tension-active substances in the mix many of which are not conducive to good whipping.

3. The reestablishment of the normal fat globule membrane by emulsifying butter in a "membrane suspension" completely restores the whipping properties of the mix containing this reconstructed cream.

4. Whipping properties of ice cream mixes, made from butter or butter-oil, can also be restored to normal by first making stable emulsions of them with dried egg yolk as the emulsifying agent and then incorporating them into mixes.

5. The addition of "membrane suspension" or egg yolk directly to the mixed and in the same concentration as that used in the emulsions, results in partial restoration of whipping properties.

6. When butter is emulsified with egg or milk phospholipids, stable emulsions result and whipping properties are restored nearly to normal, while butter-oil, treated in the same manner, results in very unstable emulsions and little aid to whipping is noted. The results indicate that the protein of "curd" portion of the butter is largely responsible for the stability of the emulsions made with butter and the subsequent restoration of whipping properties. A hypothesis is offered, suggesting that the protein or "curd" portion of butter is largely membrane protein.

7. The preparation of the emulsion of butter with skimmilk before processing, results in a stable emulsion but is of no aid to the whipping properties of the mix. Buttermilk, used in the same way with butter aids whipping somewhat, while emulsions made with the "membrane suspension" restore whipping to normal.

8. Commercial vegetable lecithin and starch when used as emulsifiers of butter-oil produce very unstable emulsions and are both deterrents to overrun development.

9. To have normal whipping properties in mixes made from a butter or butter-oil, it is essential that a protein-phospholipid complex or membrane, be present on the surfaces of the fat globules in the mix. The use of egg yolk or "membrane suspension" which furnishes this adsorption complex in a relatively pure form, demonstrates this fact. M.J.M.

**250. A Comparison of Pressure and Centrifugal Homogenization of Ice Cream Mixes.** J. C. Hening, N. Y. Agr. Exp. Sta., Geneva, N. Y. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *2*, p. 117, Oct., 1936.

The improvement in body, texture, and quality of ice cream prepared from pressure homogenized ice cream mixes as compared with unhomogenized mixes is universally recognized. Centrifugal homogenization with a colloid mill is another type of homogenization. This study was conducted because

in the literature no data could be found comparing pressure and centrifugally homogenized mixes.

The two-stage homogenization of ice cream mixes at low pressures produced mixes which were similar in viscosity and size of fat globules to mixes processed with the centrifugal colloidal mill, except that the colloidal mill ice cream mixes contained no fat globule clumps. The ice creams prepared from these mixes containing gelatin were likewise similar in body and texture.

When ice cream mixes prepared without gelatin were homogenized with pressures on the first stage ranging from 4000 to 1000 pounds, decreasing at 500 pound intervals with a constant pressure of 500 pounds on the second stage, they showed a gradual decrease in viscosity from 4000 pounds to zero pressure. The colloidal mill mixes were a little less viscous than the unhomogenized mixes. The fat globules showed a slight increase in size from 4000 to 2500 pounds pressure with greater increases at each succeeding reduction in pressure.

The texture and quality of the ice creams were good at the high pressures with a trace of coarseness at the 2500 pounds pressure. The ice creams prepared from mixes processed at the lower pressures were coarse and the centrifugal colloidal mill ice cream was a trifle coarser than the unhomogenized ice cream.

When ice cream mixes prepared without gelatin were homogenized with a constant pressure of 2500 pounds on the first stage and the pressure on the second stage was decreased from 2000 to 500 pounds at 500 pound intervals, the 2500 first-stage and 2000 pound second-stage pressure mixes were more viscous, contained larger fat globule clumps and whipped a little less readily than the mixes with a greater difference in pressure between the first and second stage. The body and texture of the ice creams prepared from these mixes were similar. M.J.M.

**251. Distribution Costs of Products.** W. C. Blunk, Golden State Co., San Francisco, Calif. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs., Oct., 1936.

There are two important reasons for keeping accounts; first, to record and help preserve the business assets and, second, to assist in managing the business more efficiently.

The cost of distributing ice cream has a greater bearing on the ultimate sales value than any other single factor, consequently an important bearing on net profits. Grouping all routes together in figuring delivery costs gives an overall average. For managerial control we have found this overall average of little value and, therefore, find it necessary to figure costs for each route separately.

Mileage is frequently used as a basic factor in figuring route costs. "Time" proved to be a more accurate basis than mileage. Repeated studies

have shown us that the time factor follows more accurately labor costs, truck depreciation, and even truck maintenance or gas and oil consumption than any other factor. Seasonal variations in consumption must also be determined in a study of distribution costs.

For each of our routes a graph is made on which the total costs per unit (plus "budgeted earnings") is plotted against the number of units delivered daily. When the units delivered daily crosses the line of total costs, the route is obviously a profitable one.

Graphs for three different routes are shown and their significance is explained. In these charts the costs involved in the operation of an ice cream route are shown graphically in such a way that they should prove helpful to one interested in determining delivery costs.

Discussion, led by Jesse S. Bloom, Abbott's Dairies, Inc., Philadelphia, Pa.

Until recently ice cream manufacturers have taken an academic interest in the matter of distribution costs. Many companies have determined other costs carefully but have lumped delivery or selling costs into one sum. It appears essential that in the future distribution costs must be figured with sufficient accuracy that these cost figures be acceptable to Federal taxing agencies. M.J.M.

**252. Sonic Vibration of Ice Cream Mixes.** E. O. ANDERSON, Conn. State College, Storrs, Conn. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *2*, p. 126, Oct., 1936.

In this study mixes treated by sonic vibration were compared with pressure homogenized mixes.

An electromagnetic oscillator similar to those used in submarine communication and echo depth sounding consisting essentially of a heavy, loaded, steel membrane actuated by alternation in an electromagnetic circuit was used. The rate of oscillation of the diaphragm was 360 cycles per second. The opening through which the ice cream mix passed between the diaphragm and the reflecting plate could be reduced to any desired value in steps of 0.01 inch. The capacity of the oscillator was 250 gallons an hour.

The results of the experiment show that when ice cream mix is directed to the oscillator under positive pressure, the freezing and whipping time of the oscillated mix compares favorably with that of homogenized milk. In some instances the time required to reach 100 per cent overrun was less with oscillated treated than with homogenized milk.

The body and texture of an oscillated gelatin and egg powder mix compared favorably with homogenized mix made from the same ingredients.

A small amount of gelatin was found necessary to secure a smooth body with oscillated mix both in the continuous and batch freezer as compared with homogenized mix.

When butter was used as the source of fat oscillated mix made as smooth a product as homogenized milk.

The simple construction of the oscillator makes it easy to clean and sterilize. The apparatus is very simple to operate. M.J.M.

**253. Analysis of Ice Cream Sales.** Special Bulletin No. 55. Intern. Assoc. Ice Cream Mfgrs., 1105 Barr Building, Washington, D. C. March, 1937.

This bulletin contains an analysis of sales of bulk and package ice cream and novelties for the year 1935. Bulk ice cream sales represented 58.6 per cent of total sales, cups 4.12 per cent, novelties and specialties 20.32 per cent, and packages 17 per cent. Though bulk sales represent a major portion of total sales, there has been a definite increase in the sales of packages and novelties.

The exact profits for the various kinds of ice cream were not determined. However, 94.62 per cent of the manufacturers reporting stated that bulk ice cream was most profitable. To the question, Why have you developed the sale of packaged ice cream, 36.33 per cent of manufacturers said, to meet competition; 26.17 per cent, to meet consumer demand; 23.44 per cent, to meet dealer demand; 11.72 per cent, to utilize advertising space on the packages; and 2.34 per cent, so as to sell two qualities of ice cream. M.J.M.

**254. A Comparison of Pressure and Centrifugal Homogenization of Ice Cream Mixes.** J. C. Henning, N. Y. Agr. Exp. Station, Geneva, N. Y. Journal of Dairy Science *19*, 11, p. 707, Nov., 1936.

When homogenizing with the two stage pressure machine the texture of the ice cream was best when the first valve pressure exceeded 2500 pounds and the mix viscosity was lowest with a pressure of 500 pounds on the second stage. The centrifugal homogenizer was not as satisfactory as the pressure machine for ice cream purposes. A.C.D.

**255. Why Do They Eat Ice Cream?** P. H. Tracy, Univ. of Illinois, Urbana, Illinois. Ice Cream Trade J. *31*, 8, p. 11, Aug., 1935.

Students in ice cream manufacturing have for several years recorded the reasons people gave for eating ice cream. These people were of various ages, both sexes, and employed in many different occupations. Of the 1422 persons studied most of them said they eat ice cream because of its palatability. This fact alone should point out to ice cream manufacturers the necessity of using high quality ingredients, proper sanitation, and proper handling. The second important reason given for eating ice cream was the refreshing sensation it gives the consumer. Hence care must be used to regulate the solids content of ice cream as a high solids content does not give the cooling effect that a low solids ice cream will. Twelve per cent of those questioned gave food value as their reason for eating ice cream. Convenience was an important factor in trade with housewives. Of the 1422

persons that gave reasons only 49 objected to it. A suggested motto for the industry might be "Nine hundred ninety-three out of every thousand like it." W.H.M.

**256. Using Frozen Cherries in Cherry Ice Cream.** J. C. HENING, N. Y. State Agr. Exp. Station, Geneva, N. Y. Ice Cream Trade J. *31*, 11, p. 16, Nov., 1935.

Recent experimental studies using five different common varieties of cherries, previously frozen, in the manufacture of cherry ice cream points out that two of these varieties are better than the others. They are: the Giant and the Napoleon sweet. The Montgomery was best of the other varieties, although Phillipe and Royal Duke were good.

The cherries were packed in the ratio of four parts cherries to one part sugar in the first trials, but this amount was not sufficient. The cherries were added to the freezer near the beginning or middle of the freezing process. Addition of extra sugar to the mix was not as satisfactory as adding it to the cherries.

A satisfactory cherry ice cream can be made as follows: add 11 pounds of Montgomery cherries packed 4 to 1 plus 2.5 pounds of sugar, thawed and soaked in their own syrup for 20 hours, to 31.5 pounds at the start of the freezing process. After hardening the cherries were not hard or icy and gave and excellent flavor to the ice cream. W.H.M.

**257. Sodium Alginate as a Stabilizer in Manufacturing Ice Cream.** M. J. MACK, Mass. State College, Amherst, Mass. Ice Cream Trade J. 32, 11, p. 33, Nov., 1936.

Sodium alginate, when properly incorporated in the mix, proved to be satisfactory stabilizer for ice cream. Advantages claimed for this stabilizer in ice cream are: no aging of mix is necessary, a higher maximum overrun can be obtained when the whipping period is prolonged, the mixes whip more rapidly and reach 100 per cent overrun more quickly than those containing gelatins, and it is more effective than other stabilizers in improving the texture of the ice cream.

Considerable precaution must be taken in order to secure a satisfactory solution. The mix should be heated to 160° F. before the sodium alginate is added, failure to do so will result in sticky, somewhat insoluble lumps.

The amount of sodium alginate used in a mix is approximately the same as the amount of gelatin used. The recommended methods of adding sodium alginate to the mix are: (1) Mix the sodium alginate through part of sugar, and then sift this sugar-stabilizer mixture slowly over the surface of the hot mix (160° F.–165° F.) W.H.M.

**258. Trends in Ice Cream Costs.** O'NEAL M. JOHNSON, Statistical and Accounting Bureau, Intern. Assoc. Ice Cream Mfgrs. Ice Cream Trade J. *32*, 11, p. 37, Nov., 1936.

The author divides ice cream costs into: product cost, manufacturing expense, selling expense, delivery expense, and administrative expense, and gives a five year trend (1931–1936) of these various items for the United States as a whole and by districts.

The five year trend for the United States shows a decrease in total, delivery, distribution, manufacturing and administrative costs, and an increase in production and sales expense.

The facts presented can be used as a measuring stick of the efficiency of the individual manufacturer, and should yield such information which can be used to reduce the cost of the ice cream manufacturer. W.H.M.

**259. The Industry: Advertising. Anonymous.** Ice Cream Trade J. *32*, 12, p. 9, Dec., 1936.

Statistical information compiled by the International Association of Ice Cream Manufacturers showed an expenditure of $5,660,000 for advertising, or 2.83 cents per gallon, in 1935.

Quality appeal is the item used most in advertising. Economy and convenience appeals were used the least. Seventy per cent of the advertising done was devoted primarily to the consumer.

The main advantages of an advertising budget are that it makes possible a well planned and well balanced advertising campaign, and makes it easier to control the advertising activities. W.H.M.

**260. Finding the Distribution Cost.** W. C. Blunk, Golden State Co. Ltd., San Francisco, California. Ice Cream Trade J. *32*, 12, p. 17, Dec., 1936.

The cost accounting of ice cream business can be divided into three important phases; namely, product cost, manufacturing cost, and distribution cost. The distribution cost is the more complex of the three.

The cost of distributing ice cream has in many respects a greater bearing on the ultimate sales value than any other single factor, and consequently it has a very important bearing on the final net profit.

Time is the most common factor in the distribution cost, and has a direct bearing on labor cost and truck depreciation.

The type of service, stops at hotels and restaurants, or straight store delivery are factors in the cost of distribution. The route serving hotels and restaurants is put at a disadvantage when compared to a route serving only straight store stops.

Distribution costs for various kinds of stops are given. W.H.M.

**261. Locating, Equipping, and Operating Retail Stores for Ice Cream.** Clyde A. Fowler, Ice Cream Trade J. *32*, 12, p. 21, Dec., 1936.

The author discusses the essential factors of a successful ice cream retail store. W.H.M.

**262. Improved Refrigeration Facilities will Lower Production costs.** HERMAN VEHEI. Ice Cream Trade J. *32*, 12, p. 25, Dec., 1936.

The author gives 0.319 KW-hr. per gallon of ice cream as a theoretical cost basis for a plant. He derived this figure by taking into account the following items:

| | |
|---|---|
| Ammonia compressor | 0.185 |
| Condenser pump | 0.040 |
| Pasteurizer | 0.004 |
| Homogenizer | 0.004 |
| Ripening vats | 0.008 |
| Aerator water pump | 0.004 |
| Freezer | 0.060 |
| Room load | 0.014 |
| | 0.319 KW-hr. per gallon |

If it is desired to make comparisons of a plant, the author states that the power consumption should not exceed 0.71 KW-hr. per gallon if load factor is 45 per cent. To obtain correct load factor, divide your average monthly production by your greatest monthly production. To obtain power consumption, divide the theoretical cost per gallon by load factor. W.H.M.

**263. A Five Point Sales Program.** W. J. MONAGHAN, Borden Co., New York, N. Y. Ice Cream Trade J. *33*, 3, p. 14, Jan., 1937.

Wholesale ice cream manufacturers have had to change their merchandising methods since the introduction of the manufacturers owned retail stores. An analysis of the factors responsible for large volume of ice cream sales in retail outlets indicated that success was due to the fact that they were specialty stores, dominated by ice cream, with plenty of light, offering a wide variety of flavors and better values. To compete with this new competition a five point program was suggested for increasing the per capita consumption of ice cream. In the main it consists of, developing the right attitude in the organization towards ice cream, securing a sympathetic attitude on the part of the dealer towards ice cream, and follow through with a well planned advertising and sales promoting campaign. W.H.M.

**264. Sales for 1936 Swing Upward.** O'NEAL M. JOHNSON, Intern. Assoc. Ice Cream Mfgrs. Ice Cream Trade J. *33*, 1, p. 31, Jan., 1937.

Statistics collected from 673 plants in the United States and 23 Canadian plants showed an increase of 20.64 and 9.82 per cent respectively for the period January 1 to August 31, 1936, over the same period in 1935. Better business conditions and favorable weather were the contributing factors. W.H.M.

**265. Advertising Appeals.** Editorial, Ice Cream Trade J. *33*, 1, p. 35, Jan., 1937.

When the advertising themes used by ice cream manufacturers are compared with the reasons given by consumers for eating ice cream, indications are that too much advertising is directed to food value and too little to the sensory appeals. The following table of percentages taken from two recent surveys is presented to illustrate these facts.

| Percentages compared | Advertising themes | Why consumers eat ice cream |
|---|---|---|
| Sensory appeals | 32 per cent | 69.3 per cent |
| Food and health value | 26.6 | 12.3 |
| Convenience | 3.5 | 7.8 |
| Economy | 2.3 | 2.2 |

W.H.M.

**266. Problems of Freezing Ice Cream by the Continuous Method.** R. J. RAMSEY, Telling-Belle-Vernon Co., Cleveland, Ohio. Ice Cream Trade J. *33*, 2, p. 21, Feb., 1937.

The composition of the mix, the method of processing, and freezing are somewhat different than for the batch freezer. Special recommendations for operating the continuous freezer are 4 to 6 hours aging period for the mix, 35 to 40° F. temperature of mix at the freezer, 3 pounds back pressure on the ammonia compressors for freezing, operation of freezers at recommended capacity, 22° F. freezing temperature, and regulate overrun with air valve only. A list of advantages and disadvantages of the continuous freezer is also presented. W.H.M.

**267. What the Man Behind the Fountain Should Know About Ice Cream.** E. N. BURNS, Garber, Peters, and Jacoby Co., Inc., Allentown, Pa. Ice Cream Trade J. *33*, 2, p. 29, Feb., 1937.

This paper discusses some of the important points in which fountain men should be trained about ice cream in order that sales of ice cream may be increased.

The topics discussed are—history of the ice cream industry, processes of manufacture, control of manufacture, place of local company in the community, food value of ice cream, profit value of ice cream, weight of ice cream, proper materials to use with ice cream, the right method of dipping ice cream, correct temperature for dipping ice cream, proper glassware at the soda fountain, rotation of packaged ice cream, cleanliness at the fountain, proper display of advertising, power of suggestion, and the fancy form business and its possibilities. Considerable information of value to soda fountain operators is given in this article. W.H.M.

**268. Build Your Merchandising Program on the Confidence of Consumers.** W. H. E. REID, Univ. of Missouri, Columbia, Mo. Ice Cream Trade J. *33*, 3, March, 1937.

The author described various ways for improving the consumer-acceptance of ice cream. Maintenance of high quality, proper attention to sanitation at the point of sale, serving at the correct temperature, and the protection of ice cream against deterioration after it leaves the hardening room were some of the topics discussed. By devoting the necessary attention to the choice of high quality raw materials, effective processing and freezing of the ice cream, and the adoption of an efficient merchandising program, consumer's acceptance may be enhanced. W.H.M.

**269. The Profitable Retail Store.** KENNETH WALLACE, Franklin Creamery Co., Cleveland, Ohio. Ice Cream Trade J. *33*, 3, p. 13, March, 1937.

The success of the retail store, which now is an established outlet for ice cream, will depend upon the intelligent application of the principles of good management. Product, service and price are the three essential factors which will determine the success of the store. W.H.M.

**270. You Can't Do a Merchandising Job if You Don't Have Proper Tools.** GEORGE HENNERICH, Mgr., Ice Cream Merchandising Institute, Inc. Ice Cream Trade J. *33*, 3, p. 17, March, 1937.

Merchandising of ice cream has not kept pace with improvements in manufacturing facilities. In order that a better job of merchandising ice cream may be done, the Merchandising Institute has prepared a number of tools which may be used. The author gives specific information on how these various tools may be used advantageously by the ice cream salesman. W.H.M.

**271. Bigger Sales for Ice Cream** AUBYN CHINN, National Dairy Council, Chicago, Illinois. Ice Cream Trade J. *33*, 3, p. 23, March, 1937.

This article describes material presented at many ice cream conventions throughout the United States during the past few months. The author suggests the following sales potentialities for ice cream.

1. Place before the professional leaders in the medical and educational fields, the quality and superior food value of commercial ice cream.
2. Integrate projects and material on ice cream in the regular educational program in schools.
3. Increase consumer education through all channels such as newspaper editorials, leaflets for direct mail to consumers, food demonstrations.
4. Stimulate increased use of ice cream for young adults in factories and offices for between-meal pick-up through appeals to beauty, weight control, and physical fitness. W.H.M.

**272. Ice Cream in the 1935 Census.** Anonymous. Ice Cream Trade J. *23*, 3, p. 27, March, 1937.

Data collected by the Bureau of Census indicate the production of 237,-

258,394 gallons of ice cream, ices and specialties in the United States during 1935 representing an increase of 52.6 per cent over the 1933 production. Other interesting statistics presented include the number of wage earners, wages paid, cost of materials, value of product, and the amounts of various frozen products manufactured. W.H.M.

**273. What Should Stabilizers Do?** V. C. STENNITZ, Dept. of Dairy Industry, Univ. of Wisconsin, Madison, Wis. Ice Cream Trade J. *33*, 3, p. 35, March, 1937.

The author of this article lists the purposes for which stabilizers are used in ice cream, classifies stabilizers and discusses the advantages and disadvantages of various stabilizers. Most of the discussion deals with the merits of sodium alginate as a stabilizer for ice cream. He concludes, "Sodium alginate as an ice cream stabilizer appears to posses all the desirable properties of gelatin and in addition has some distinct advantages. Notable among these advantages are the uniformity of viscosity of the mix, the faster shipping, and the desirable melt-down of the ice cream."

W.H.M.

**274. Applying to Ice Cream the Minnesota Babcock Butterfat Test.** L. M. THURSTON AND W. C. BROWN, Dept. Dairy Husb., West Va. Univ. Ice Cream Field *30*, 4, p. 8, Feb., 1937.

The authors summarize the results of this study, which was designed to compare the accuracy of the Minnesota Babcock test with the gravimetric method, as follows:

1. The Minnesota method failed consistently to give satisfactory results either with chocolate milk or chocolate ice cream.

2. Satisfactory results were obtained for ordinary ice cream and concentrated milks when the following conditions are taken into consideration.

(a) Samples digested at temperatures of 200°–210° F. yielded more nearly accurate results, on the average, than those digested at 180°–185° F.

(b) The accuracy of the test with ice cream and concentrated milks varied with the shaking procedure during digestion. Shaken samples tended to yield results that are too high, whereas the unshaken samples tended to yield results that were too low. The best results were obtained by shaking the samples vigorously at the time when at least half of the contents of the bottle have turned dark brown (usually about 2½ minutes after placing them in the water bath). The samples should be shaken vigorously again about one minute later.

(c) Digestion periods of 20 minutes or longer tended to give results that became progressively lower as the time of digestion bath increased. However, the reduction in reading due to 15 minutes digestion as compared to that due to 10 minutes is not great and would not seem to be a factor seriously affecting the accuracy of the test. Observations on the digestion of

the samples at the temperature of boiling indicate 10 minutes is required as a minimum for satisfactory results. Accordingly, a digestion period of 10 to 15 minutes is recommended.

(d) The use of a reading fluid is recommended, because it causes sufficient reduction in the results to cause the samples that were shaken vigorously during digestion. and consequently gave high results which did not vary more than 0.1 per cent on the average from the results shown by the gravimetric method. W.C.

**275. Facts About Ice Cream the Soda Dispenser Should Know Thoroughly.** E. N. BURNS, Mgr. Garber-Peters Jacoby Ice Cream Co., Allentown Pa. Ice Cream Field *30*, 5, p. 18, March, 1937.

The author claims among other things that in order to have the dispenser enthusiastic about the ice cream which he sells he should be familiar with: the historical development of the industry, the process of manufacture of ice cream and the provisions for control of its quality, and the food value of ice cream. He states that often ice cream specials sell for more than they should and conclude that "a soda fountain product containing ice cream should not be sold for more than twice the cost of the ingredients."

He emphasizes the necessity of teaching the dispenser how to dip ice cream, how to keep the fountain clean, and how to properly display advertising material. W.C.

Abstracts of interest are numbers 198, 201, 205, 207, 208, 209, 210, 211, 218, 228, 229, 230, 231, 232, 235, 276, 277, 278, 279, 280, 282, 283, 284, 285, 287, 288, 289, 291, 296, 305, 307, 308, 309, 311, 312, 313, 314, 315, 316 and 317.

## MILK

**276. The Grading of Raw Milk on the Basis of Bacterial Cleanliness.** G. S. WILSON, London School of Hygiene and Tropical Medicine, London, England. Proc. 29th Ann. Conv. Intern. Assoc. of Milk Dealers, Lab. Section, p. 11, 1936.

After a discussion of the most important available tests reasons are brought to show that a modified methylene blue reduction test is peculiarly well suited for the grading of raw milk. The test is modified by holding the samples at atmospheric temperature for a definite period of time before adding the methylene blue to permit the heavy contamination of milk produced under bad sanitary conditions to become operative, and by stoppering and inverting the tubes each half hour during the test to break up the cream layer and secure more uniform reduction. E.F.G.

**277. Factors Affecting the Viscosity of Market Cream.** H. B. HENDERSON, Univ. of Tenn., Knoxville. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 21, 1936.

Various conditions of separation, agitation, heating and cooling of milk in many cases resulted in significant differences in the viscosity of raw cream but in the pasteurized product these differences were not large enough to be of very great significance.

With regard to increasing the viscosity of cream by the method described by Hening and Dahlberg the viscosity of fresh and aged pasteurized cream was increased by subjecting the cream to a temperature treatment of 80° to 90° F., the greater increase being obtained with a temperature of 80° F. E.F.G.

**278. Discussion of Factors Affecting Cream Viscosity.** A. C. DAHLBERG, N. Y. Agr. Exp. Sta., Geneva. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 36, 1936.

A heat treatment of cream to increase viscosity recently developed at Geneva and previously published is discussed. E.F.G.

**279. Control of the Oxidized Flavor in Milk.** GEORGE R. GREENBACK, U. S. Dept. of Agr., Washington, D. C. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 101, 1936.

When cows go on pasture the "oxidized" flavor does not always disappear.

The oxidized flavor may develop in the milk at any time during the lactation period. It is believed that the flavor is the result of the oxidation of a minor constituent. The protective action of ascorbic acid is shown. Copper was found to be the best catalyst in producing this flavor. Ferrous iron is catalytic but ferric iron which is an oxidizing agent is an inhibitor especially in higher concentrations. Different milks vary greatly in copper tolerance.

Milks having the lowest oxidation-reduction potentials were best. An increase of 0.1 pH was sufficient to prevent the development after 24 hours in storage and decrease the intensity after 48 hours. Aeration increased copper tolerance four times while pasteurization increased it eight times. Aeration plus pasteurization gives the greatest protection.

Elimination of metallic contamination is the first step in preventing development of the oxidized flavor in milk. E.F.G.

**280. The Cause of Oxidized and Rancid Flavors in Raw Milk.** J. A. ANDERSON, Rutgers Univ., New Brunswick, N. J. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 117, 1936.

By feeding experiments it was shown that it was possible to cause a change from the production of good milk to milk which acquired either oxidized or rancid flavors simply by changing from machine cured alfalfa hay to poor field cured alfalfa. It was also possible to cause these same

animals to produce milk of good color and flavor by feeding a good quality of hay or a poor hay plus a small quantity of carrots.

The factor or factors responsible for the production of milk of good flavor is present in alfalfa dried in such a manner as to conserve color and certain accessory food factors, one of which is carotene or provitamin A. In poor field cured alfalfa these factors are deficient. The factor or factors appeared to be present in good red carrots to a considerably greater extent than in alfalfa.

In order to determine whether the good factor we are seeking is actually carotene or something associated with it in plant materials we are now preparing to feed one of the most expensive compounds ever fed to a cow, pure carotene. E.F.G.

**281. Flavors of Milk Influenced by Different Systems of Feeding Certain Roughages.** C. L. ROADHOUSE AND J. L. HENDERSON, Univ. of California, Davis. Proc. 29th Ann. Conv. Intern. Assoc. Milk Dealers, Lab. Section, p. 135, 1936.

Some new data are reported concerning the effect of alfalfa hay, corn silage, alfalfa pasturage, sudan grass pasturage, and concentrates upon milk flavor score when fed at various intervals and in various amounts with relation to the milking period. A practical procedure for controlling feed flavor in milk when the above are used is given. This includes, (1) concentrates during milking, (2) alfalfa hay immediately after milking, (3) alfalfa pasture just after milking and until four or five hours before milking, (4) free access to sudan grass pasturage until just before milking, (5) if as much as fifteen to twenty pounds of corn silage is fed it is always best to feed it after milking.

Although ideal procedure would be to withhold all roughage from the cows during the five hour period before milking the above procedure will produce a commercially acceptable milk. E.F.G.

**282. The Cleaning of Tinned Equipment in the Dairy.** G. GENIN, Engineer E. P. C. Paris, France. Le Lait *16*, 156, p. 611, June, 1936.

The corrosion of tin and tined copper by sodium carbonate and caustic soda solutions depends essentially on the quantity of oxygen dissolved in the solution and very little on the temperature and concentration of the alkali. The presence of a reducing agent allows a marked reduction in the corrosion. For this purpose sodium sulphite was found very effective. Thus pure tin on treatment with 0.5 per cent solution of sodium carbonate lost 6.6 mg. per square decimeter while when the carbonate solution contained sodium sulphite the loss was reduced to 0.8 mg. per square decimeter. Sodium sulphite has the advantage of low cost, relative stability in a solid

state, and ready solubility in water and in alkaline solution. Moreover its product of oxidation, sodium sulphate exerts no deleterious effect. By the addition of sodium sulphite, it is possible to reduce to about 1/10 the attack of alkaline solutions on tin. It is suggested that proper proportions of mixing sodium sulphite and carbonate or caustic are 1 part of sodium sulphite to 10 parts of crystallized sodium or 1 part of sodium sulphite to 4 parts of sodium carbonate or caustic soda. The protective action of the sodium sulphite on tin is exerted until all of it has been oxidized to the sulphate. E.H.J.

**283. Variations in the Carotene and Vitamin A Values of the Milk Fat (butter) of Cattle of Typical English Breeds.** Albert Edward Cillam and Isador Morris Heilbron, Chem. Dept., Manchester Univ., and William Swan Ferguson and Stephon John Watson, Imperial Chemical Industries Ltd., Jealott's Hill Research Station. Biochem. J. *30*, 1728, 1936.

Two cows from each of the main dairy breeds, Shorthorn, Ayrshire, Friesian and Guernsey, all having calved between October and November, were selected. During the last three months of the year, the winter ration consisted of hay, kale and concentrates, the kale being fed at the rate of 30–40 pounds per day. From January to April, the kale was replaced by mangolds. In May and June pasturage was plentiful, but July drought seriously affected the supply of grasses. Butter was prepared from the colostrum, and from the milk thereafter at monthly intervals. The carotene and vitamin A were determined on the unsaponifiable matter by absorption spectra methods. The results show that individual variations among the cows of the same breed are large but that the carotene and vitamin A values are more dependent upon diet than on the stage of lactation. For the four breeds, Shorthorn, Ayrshire, Friesian, and Guernsey, the following gross average values expressed as Mg./100 gm. fat on the normal milk were Carotene, 0.27; 0.36; 0.40; 0.92. For vitamin A, 0.68; 0.85; 0.90; 0.75. For calculated growth promoting activities as Y per gram (B carotene units) 9.5; 12.1, 13.0; 16.7. High vitamin A and carotene values were observed in the colostrum milk. Approach of the end of the lactation period does not appear to affect the vitamin A or carotene values.

The vitamin A may vary as much as 300 per cent and the carotene 400 per cent during the lactation period. K.G.W.

**284. Variations in the Vitamin C Content of Milk.** C. H. Whitnah and W. H. Riddell, Kansas Agr. Exp. Sta., Manhattan, Kansas. Journal of Dairy Science *20*, 1, p. 9, Jan., 1937.

The vitamin C content of fresh cow's herd milk could not be materially increased by feed but remained fairly constant at 23 to 30 milligrams per liter. A.C.D.

**285. The Rate of Change in the Vitamin A Content of Milk.** W. C. Loy, J. H. Hilton, J. W. Wilbur and S. M. Hauge, Purdue Univ. Agr. Exp. Sta., Lafayette, Indiana. Journal of Dairy Science *20*, 1, p. 31, Jan., 1937.

About 11 days were required for changes in vitamin A in the feed of cows to reach an equilibrium level in the milk. A.C.D.

**286. The Composition of the Colostrum of the Dairy Goat.** A. J. Bergman and C. W. Turner, Univ. of Missouri, Columbia, Mo. Journal of Dairy Science *20*, 1, p. 37, Jan., 1937.

The composition of the colostrum of the milk of six goats was determined for a period of nine days following parturition. A.C.D.

**287. The Relation of the Oxidation-Reduction Potential of Milk to Oxidized Flavor.** R. E. Webb and J. L. Hileman, Dairymen's League Coop. Assoc., Syracuse, N. Y. Journal of Dairy Science *20*, 1, p. 47, Jan., 1937.

In general a relationship was found to exist between the oxidation-reduction potential of milk and the tendency to develop oxidized flavor.

A.C.D.

**288. A Further Study of the Factor in Soybeans Affecting the Vitamin A Value of Butter.** S. M. Hauge, J. W. Wilbur and J. H. Hilton, Purdue Univ., Agr. Exp. Sta., Lafayette, Indiana. Journal of Dairy Science *20*, 2, p. 87, Feb., 1937.

The vitamin A suppressing factor in soybeans which interferes with the transference of the vitamin A activity of the feed to the butterfat secreted by dairy cows was found to be distributed in both the soybean oil and soybean oil meal secured by either the expeller process or by chemical solvents.

J.C.H.

**289. Oxidized Flavor in Milk. IV. Studies of the Relation of the Feed of the Cow to Oxidized Flavor.** W. Carson Brown, L. M. Thurston, and R. B. Dustman, West Va. Agr. Exp. Sta., Morgantown, West Va. Journal of Dairy Science *20*, 3, p. 133, March, 1937.

Green feeds fed to cows altered the milk to distinctly decrease the tendency toward oxidized flavor. A.C.D.

**290. The Use of Formate-Ricinoleate Broth in Controlling and Preventing Ropy Milk Epidemics.** L. R. Curtis, Dairymen's League Coop. Assn., Syracuse, N. Y. Journal of Dairy Science *20*, 3, p. 147, March, 1937.

Formate-ricinoleate broth was found to be very effective in detecting sources of plant contamination of the milk supply with ropy milk bacteria. A.C.D.

**291. A Study of Oxidized Flavor in Commercial Pasteurized Milk.** C. T. ROLAND, C. M. SØRENSEN, AND R. WHITAKER, Sealtest System Labs., Inc., Baltimore, Md. JOURNAL OF DAIRY SCIENCE *20*, 4, p. 213, April, 1937.

Oxidized flavor was found to be the predominant flavor in commercial pasteurized milk and it occurred in 21 per cent of the samples. A.C.D.

**292. Britain's Largest Dairy.** JOHN ASHTON, Corpus Christi, Texas. Milk Dealer *26*, 4, p. 34, Jan., 1937.

The author gives a complete description of the Express Dairy Co., Ltd., which serves millions of consumers in London and vicinity. C.J.B.

**293. Factors Influencing the Formation of Milk Layer in Bottled Coffee Cream.** L. H. BURGWALD AND J. L. MOONEY, Ohio State Univ., Columbus, Ohio. Milk Dealer *26*, 4, p. 40, Jan., 1937, Milk Dealer *26*, 5, p. 72, Feb., 1937.

This work was undertaken in an effort to determine some method whereby plant practice might be adapted to the control of the formation of milk layer in the bottled coffee cream, as sold on the market.

Customary milk plant practice is established as pasteurizing the milk at 145° F., cooling to a temperature of about 110° F. and separating. Coffee cream is usually secured by standardizing heavy cream to the desired fat content by use of either whole or skimmilk. The maximum milk layer at the end of 12 hours, when creamed at a temperature of 42 to 50° F., was 13.10 per cent of the total volume, the minimum milk layer was 1.28 per cent of the volume.

Seasonal influence is a factor in the formation of the milk layer. Control of the milk layer is more difficult in the spring of the year.

Pasteurization of the milk at 155° F. and separating at 110° F. reduced the amount of milk layer. Likewise, the pasteurization of the cream at 155° F., for 30 minutes reduced the depth of the milk layer. The viscosity of the cream was decreased. These effects were associated with precipitation of the calcium by heat.

An increase in the temperature of separation will decrease the depth of the milk layer and will decrease the body of the cream. C.J.B.

**294. How the Milk Market was Stabilized in Port Arthur, Texas.** J. C. WATKINS, Port Arthur Chamber of Commerce, Port Arthur, Texas. Milk Dealer *26*, 4, p. 43, Jan., 1937.

The author points out that with milk retailing at five cents a quart in a market having two pasteurized milk distributors and some 60 producer-dis-

tributors, the outlook for the milk industry in Port Arthur five years ago was pretty dark. He then describes how cooperative action between producers, distributors, consumers, and the local chamber of commerce resulted in organization of the industry and price stabilization that has stood the time test of five years of successful operation. C.J.B.

**295. Do Your 1937 Consumers Know?** J. H. FRANDSEN, Mass. State College, Amherst, Mass. Milk Dealer *26*, 4, p. 44, Jan., 1937.

The author reviews the virtue of milk as a food and reminds the dairy industry that because of a new generation every year, they must continue to boost the extensive use of dairy products. C.J.B.

**296. Practical Laboratory Tests for Measuring Milk Quality.** STANLEY W. WHITSON, Univ. of Nebraska. Milk Dealer *26*, 4, p. 70, Jan., 1937.

The author discusses some of the advantages and disadvantages of such laboratory tests as the standard plate culture method, direct microscopic method, Frost little plate method, methylene blue reduction test, bromthymol blue test, bromcresol purple test, and the acidity test in determining milk quality. C.J.B.

**297. The Regulation and Control of Milk Supplies.** S. V. LAYSON, Division of Sanitary Engineering, Ill. Dept. of Public Health. Milk Dealer *26*, 5, p. 36, Feb., 1937.

A discussion of the development of milk regulations in Illinois. The author points out the major part which pasteurization is playing in developing a better milk supply. Evidence of the effectiveness of pasteurization is shown by the fact that there has not been a case nor an epidemic of milk-borne disease in Illinois traced to pasteurized milk since health officials assumed charge of the sanitary supervision of down-state pasteurization plants in 1926, as compared to the fact that nearly each year raw milk has been responsible for illness and death. C.J.B.

**298. Bottle Washing Alkalies and Their Application in Milk Plants.** HANS EDEL, Gehl's Guernsey Farms, Milwaukee, Wis. Milk Dealer *26*, 5, p. 42, Feb., 1937.

The author discusses the importance of knowing the exact percentage of causticity in the soaking compartment of bottle-washing machines. Suggestions for maintaining the correct percentage of causticity are also given. C.J.B.

**299. Place of the Standard Milk Ordinance in the Marketing of Milk.** LEON BAUMAN, President, Kansas Association of Milk Sanitarians. Milk Dealer *26*, 5, p. 44, Feb., 1937.

A discussion of the Standard Milk Ordinance based on the essential

points to any good milk ordinance, as set forth in the report of the White House Conference of 1928 on Health, and on its application in the State of Alabama. C.J.B.

**300. Current Trends in Milk Consumption**—August-October, 1936. EDWARD FISHER BROWN, Milk Research Council, Inc., New York City. Milk Dealer *26*, 5, p. 47, Feb., 1937.

The author gives a comprehensive report of the performance of the fluid-milk market in metropolitan New York, Boston, and Philadelphia during the period August to October, 1936. C.J.B.

**301. Refrigerated Retail Delivery Trucks.** Milk Dealer *26*, 5, p. 48, Feb., 1937.

Description of a retail delivery truck in which a series of drawers, which may be sized so as to accommodate cases filled with bottles or to accommodate bottles only, is refrigerated. A considerable saving in the cost of refrigeration is claimed for this new type of delivery truck. C.J.B.

**302. The Changing Picture of Fluid Milk Marketing.** LELAND SPENCER, Cornell Univ., Ithaca, N. Y. Milk Dealer *26*, 5, p. 82, Feb., 1937.

A discussion of the developments which have considerably changed the situation and conditions with which fluid milk cooperatives have to deal is given. C.J.B.

**303. Public Health Features in Milk Plant Layout.** RALPH E. IRWIN, Bureau of Milk Sanitation, State Dept. of Health, Harrisburg, Pa. Am. J. Pub. Health *27*, 1, p. 37, 1937.

The regulations and plans presented in this article are for the purpose of obtaining compliance with Pennsylvania law. The main public health features are (1) a milk room protected from flies and located so that it cannot be used as a passageway, (2) equipment located so that every part is accessible for cleaning, (3) the processing of milk and the cleaning and filling of containers carried on in progressive steps without "back tracking" (4) a steam tight surface for walls and ceilings and ventilation to prevent condensation on walls and ceilings and (5) sanitary features that make it easy to handle milk and cleanse containers in a clean manner. M.W.Y.

**304. The Use of Wooden Vessels for the Transportation of Milk.** G. GENIN, Engineer E. P. C. Paris, France. Le Lait *16*, 158, p. 841, Sept.–Oct., 1936.

It was found that oak tanks painted with resistant paint could be used for the transportation of milk without odors or flavors from the container affecting the quality of the milk in any way. Many paints had to be studied to find those that would withstand the action of the milk and the dairy detergents used for cleaning. A.H.J.

**305. Oxidized Flavor in Milk. II. The Effects of Homogenization, Agitation and Freezing of Milk on its Subsequent Susceptibility to Oxidized Flavor Development.** L. M. THURSTON, W. CARSON BROWN AND R. B. DUSTMAN, West Va. Agr. Exp. Station, Morgantown, West Va. JOURNAL OF DAIRY SCIENCE *19*, 11, p. 671, Nov., 1936.

Homogenization, severe agitation, and partial freezing of milk all tended to reduce the tendency of milk to become oxidized in flavor. A.C.D.

**306. The Hygienic Control of Milk at Nancy.** H. BAUDEAU, Veterinary Inspector, Nancy, France. Le Lait *16*, 159, p. 946, Nov., 1936.

In improving the milk supply for the city of Nancy, France, the following determinations were made: density, fat by the Gerber method, temperature, filtration, and organoleptic examination of the milk when received at the dairy, acidity, reductase test, catalase test, reactions of Schardinger, Dupouy, and Schern-Gorli, bacteria count, colon bacilli examination, and centrifugation and examination of the precipitate. A.H.J.

**307. Factors Affecting the Activatability of Milk with Ultra-Violet Light.** W. E. KRAUSS, R. M. BETHKE, AND R. G. WASHBURN, Dept. Dairy and Animal Ind., Ohio Exp. Sta., Wooster, Ohio. JOURNAL OF DAIRY SCIENCE *19*, 12, p. 739, Dec., 1936.

It was found that the activatability of milk by irradiation increased directly with the fat content and was also affected by the breed of the cows which produced it. A.C.D.

**308. Cleaning Dairy Equipment with Trisodium Phosphate.** L. A. ROGERS AND FRED R. EVANS, Bureau of Dairy Ind., U. S. Dept. of Agr., Washington, D. C. JOURNAL OF DAIRY SCIENCE *19*, 12, p. 733, Dec., 1936.

The use of trisodium phosphate with sodium chromate was found to be particularly efficacious in cleaning separators and milking machines. A.C.D.

**309. Oxidized Flavor in Milk. III. The Time of Copper Contamination During Production and Processing, and Aeration Versus no Aeration as Related to Oxidized Flavor Development.** W. CARSON BROWN, L. M. THURSTON, AND R. B. DUSTMAN, West Va. Agr. Exp. Sta., Morgantown, West Va. JOURNAL OF DAIRY SCIENCE *19*, 12, p. 753, Dec., 1936.

The acceleration of the development of oxidized flavor in milk by copper was most pronounced when the copper was added to the milk after pasteurization. A.C.D.

**310. Amylase in Cow's Milk.** G. A. Richardson and C. L. Hankinson, Univ. of California, Davis, California. Journal of Dairy Science *19*, 12, p. 761, Dec., 1936.

Milk contains both alpha and beta amylase, the former being inactivated at 55° C. for 30 minutes and the latter at 65° C. for 30 minutes. A.C.D.

Other abstracts of interest are numbers 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 214, 216, 217, 218, 222, 223, 224, 225, 226, 227, 228, 230, 231, 232, 233, 234, 235, 239, 240, 250, 252, 254, 262, 311, 312, 313, 314, 315, 316, 317, and 318.

## MISCELLANEOUS

**311. Use of Rubber in the Dairy Industry.** G. Genin, Engineer E. P. C. Paris, France. Le Lait *16*, 153, p. 256, March, 1936.

The author discusses the use of rubber in the dairy industry. A.H.J.

**312. Where Do Consumer's Dollars Go?** Wilford L. White, Chief Marketing Research Division, Bureau of Foreign and Domestic Commerce; Ice Cream Trade J. *32*, 10, p. 11, Oct., 1936.

The author states that we do not have enough data to know where the consumer's dollars go. With what information there is available, he has considered the question from three general points of view: (1) consumer changes, (2) consumer income, and (3) consumer expenditures.

The fundamental changes in buying habits and distribution methods and policies are being brought about by decrease in size of the family, increase in average age of the individual, redistribution graphically, stabilization in numbers and shift in occupations.

The income of a wage earner ranging from $1,300 to $1,600 for the year was spent as follows: 32 per cent for food and 74 per cent for food, clothing, and use of home.

The author also discusses the movement of consumer goods through distribution channels, allocation of expenses, location of consumers, and the family budget. W.H.M.

**313. Plant Engineering Problems in the Dairy Industry.** Bernhard O. Opitz, Western Dairy Prod. Inc., Seattle, Washington. Ice Cream Trade J. *32*, 10, p. 25, Oct., 1936.

The author classified the engineering problems as: operation, equipment, and maintenance; and subdivided the latter into: condition of brine, motors, switches, wiring, pipe covering, steam and water valves, steam traps, reducing valves, pumps, and all other equipment.

A poor power factor can be improved by such devices as rotary condensers, static condensers, synchronous motors, or fully loaded induction motors. When the plant is large enough, a static condenser is advised.

Recommendations made were: lower temperatures require lower back pressures on the compressors, heavier insulation for hardening rooms, use of electric motors rather than steam driven motors. The use of "V" belt drive for compressors, continuous freezers, and cooling hardening room by circulating rather than dead air were suggested. W.H.M.

**314. Revamping Refrigerating Systems to Cut Down Cost of Power.** HERMAN VETTER. Ice Cream Trade J. *33*, 2, p. 25, Feb., 1937.

Before any changes are made in a plant a thorough engineering analysis should be made. It is reasonable to expect a 20 per cent return on the added investment required to make the change. On basis of the amount of heat handled by a refrigeration system the condenser which handles 50 per cent is most important. The compressor handles 8.68 and the evaporator 41.31 per cent of the heat. Improvements are made when it is possible to increase efficiency, lower production costs or to increase capacity. The efficiency of a refrigeration system is dependent upon the proper balance between the three essential parts listed above. By increasing condensing surface, or additional evaporating surface, it is possible to effect savings in power requirements for compressors. Efficiency may also be raised by increasing the size of pipe lines and by the use of improved valves in the compressor. Remodeling existing equipment sometimes offers greater possibilities for increased efficiency than does the purchase of new equipment. W.H.M.

**315. The Use of Graphic Charts.** STANLEY L. KEDZIERSKI, Bureau of Foreign and Domestic Commerce, U. S. Dept. of Commerce, Washington, D. C. Proc. 36th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *3*, p. 26, Oct., 1936.

Graphic methods are used for presenting all kinds of statistical data in visual form. The usefulness of graphs lies in the clearness of their interpretations. Graphs are essential because they save time and effort in analyzing data.

Graphs may be used liberally as part of a well developed statistical research department where a few pertinent facts are recorded. Generally graphs are used for internal control of an enterprise; an executive can directly compare external conditions with the state of his own business. The sales executive finds graphs invaluable in recording (a) customer activity, (b) results accomplished by his salesmen, and (c) trend of sales for any given period. The credit manager can use graphs to discern customer conditions, thus reducing to a minimum collection cost and bad debts. The production manager can use graphs to gauge his production schedule and thereby effect economy in operation costs.

The types of graphs are classified in this paper as (1) component series,

(2) spatial series, (3) time series, (4) frequency series, and (5) organization and control series. Examples of each type of graph are given and their usefulness is discussed.

Graphic forms should be selected according to their psychological appeal and ease of interpretation, the used for whom they are intended, and the purpose which they are designed to serve. The user must not allow himself to be carried away by the romance of graphic presentation, but must adopt methods in keeping with the degree of usefulness and the purpose which such presentation is designed to serve. M.J.M.

**316. The Use of Statistics.** WROE ALDERSON, Curtis Publishing Co., Philadelphia, Pa. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *3*, p. 57, Oct., 1936.

When judging statistical information, one should consider for what purpose the figures were obtained, what method was used in securing the figures, whether they are based on actual business or on estimates and whether they represent the average of a sufficiently large number of businesses.

The leading sources of statistical information are—

1. The United States Census Bureau.
2. Bureau of Foreign and Domestic Commerce.
3. Harvard Bureau of Business Research.
4. Dun and Bradstreet.
5. The Federal Trade Commission.
6. The Association of National Advertisers.
7. The Curtis Publishing Company.
8. Trade Association Statistics.

M. J. M.

**317. Training of Youth in Preparation for Taking Its Place in the Dairy Industry.** H. F. JUDKINS, National Dairy Prod. Corp., New York, N. Y. Proc. 36th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *2*, p. 144, Oct., 1936.

First, the requirements or needs of the dairy industry of its employees are set forth in this article; secondly, the means of measuring the qualifications of the employee; and thirdly, the responsibility of the dairy industry to the men it employs.

The discussion of the above phases of the question are based on the author's experience in personnel work. M.J.M.

**318. Contemporaries of Martiny.** Molkereizeitung, Hildesheim. 1936. with historic introduction by H. Weigmann.

The title of this book may convey no meaning to most American dairymen because they never heard of Benno Martiny who was born just 100 years ago, and who, in 1871, wrote a book on the dairy industry and

founded the first Dairy Journal, and spent all his life in the organization and promotion of dairy industry and dairy science. When Hermann Weigmann celebrated his 80th birthday a year ago, the Dairy Research Institute at Kiel, Germany, presented him with a collection of 100 portraits and biographies of the "Men around Martiny," men important in the history of dairying. This collection, enlarged to a total of 124, has now appeared in print.

The book is broad in its interpretation of dairying. It contains portraits of Leeuwenhoek, Pasteur, Robert Koch, Bang; it includes men famous for their work on animal feeding like Henneberg, Voeltz, Kellner, and Eckles, engineers like De Laval, editors of dairy papers, famous cheesemakers and professors, and leaders in the dairy industry like Bolle and Borden. The book is international in its aspects, but on account of the historic emphasis, only 5 Americans are mentioned, for the American dairy industry is young compared with that of Europe. Only 20 of the 124 men portrayed are still living, but the book begins with the year 1516.

OTTO RAHN.

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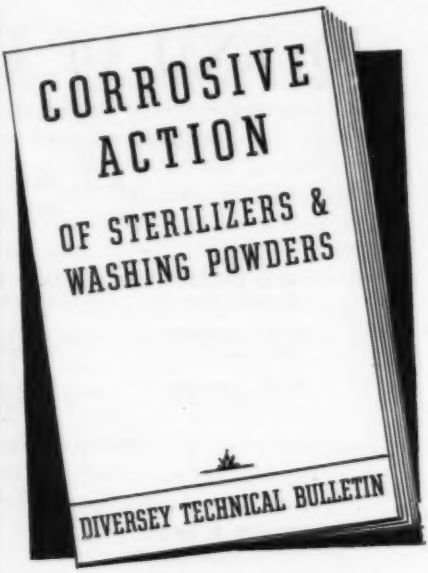


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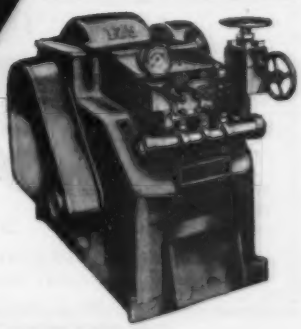

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